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**Vibration, Acoustic, and Shock  
Design and Test Criteria for  
Components on the Solid Rocket  
Boosters (SRB), Lightweight  
External Tank (LWT), and Space  
Shuttle Main Engines (SSME)**

(NASA-RP-1127) VIBRATION, ACOUSTIC, AND  
SHOCK DESIGN AND TEST CRITERIA FOR  
COMPONENTS ON THE SOLID ROCKET BOOSTERS  
(SRB), LIGHTWEIGHT EXTERNAL TANK (LWT), AND  
SPACE SHUTTLE MAIN ENGINES (SSME) (NASA)

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National Aeronautics  
and Space Administration

Scientific and Technical  
Information Branch

## PREFACE

The vibration, acoustic, and shock design and test criteria presented in this document are based on the latest SRB, LWT, and SSME structural configurations.

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## SECTION I. INTRODUCTION

This document presents the vibration, acoustic, and shock design and test criteria for components and subassemblies on the Space Shuttle solid rocket booster (SRB), lightweight tank (LWT), and main engine (SSME). Also presented are specifications for transportation, handling, and acceptance testing. Subzones (general specifications) are presented for all locations. The general configuration of the Shuttle is shown in Figure 1. Specifications are also presented for some specific components and subassemblies.

The specifications cannot provide all the information necessary for qualification testing of each individual component and subassembly. Consequently, this document must be used under the cognizance of qualified dynamics and test engineers. The originating agency, ED23, will assist in the proper use of these specifications.

## SECTION II. VIBRATION AND SHOCK QUALIFICATION TEST REQUIREMENTS AND PROCEDURES

The following requirements and procedures apply only to qualification testing:

### A. Specimen

The specimens will be production components in accordance with current manufacturing drawings. Supporting brackets and component attachment hardware (lines, valves, etc.) will be included in all tests to achieve dynamic similarity to actual installation. Hardware so included in the test setup is considered part of the test specimen.

### B. Fixture

The fixture will support the specimen in the manner simulating actual installation. The fixture will be designed to minimize fixture response at resonances within the test frequency range.

The fixture design and specimen installation should be approved by responsible dynamics and test engineers prior to testing.

### C. Test Specimen and Fixture Resonance Survey

A sinusoidal resonance survey test is recommended in the fixture and instrumentation diagnostics process and in developmental testing. The recommended sweep rate is 1 oct/min from 5 to 2000 to 5 Hz at the following amplitudes:

- 5 - 62 Hz @ 0.0050 in. D. A. Disp.
- 62 - 2000 Hz @ 1.0 G's peak

### D. Test Amplitude

All component test amplitudes will be applied as inputs to the component bracketry at the interface of the bracketry and the test fixture. The inputs will be applied along each of three mutually perpendicular axes as referenced to the interface of the component and the vehicle primary structure. The control accelerometer will be mounted on the test fixture at the point where the test specimen or specimen supporting bracketry attaches to the test fixture.

### E. Test Sequence

The qualification testing order for the components will be:

- Acceptance Vibration Test (when required) (Section V)
- Flight Random Vibration Test (SRB Motor Case, Nozzle, and SSME)
- Lift-off Random Vibration Test

- Boost Random Vibration Test
- Reentry Random Vibration Test (SRB components when specified)
- Vehicle Dynamics Test (SRB and ET)
- Shock Test
- Acoustic Test (when specified)
- Transportation and Handling Tests (when specified)

Acceptance testing, when required, should be completed in all three axes prior to any other qualification testing. All random vibration, vehicle dynamics, and shock testing should be completed in one axis before proceeding to the next. When shock testing is performed on separate test equipment, all vibration testing will be completed prior to shock testing.

#### F. Functional Performance

Specimens that function in the dynamic environment will perform to their functional specifications prior to, during, and after each qualification test.

#### G. Random Vibration Tests

Test equipment equalization will be accomplished by either of the following methods:

- Obtaining initial equalization by using actual test specimens and reduced vibration inputs. Final equalization will then be obtained by applying short duration excitation to the specimen at the specified test amplitudes.
- Subjecting a mass simulated dummy component to the specified test inputs as in the above method. After equalization, the dummy component will be replaced by the actual component, and equalization verified by applying short duration excitation at the specified test amplitudes.

Test amplitudes and durations are provided in the applicable specifications. Test setup and equalization times should be minimized. Neither of these time durations will be considered part of the specified test duration.

#### H. Vehicle Dynamics Test

Test amplitudes are provided in the applicable specifications. The specified frequency spectrum will be swept logarithmically at the rate of 3 oct/min as described below:

- Single Mission — Sweep from the low frequency to the high frequency one time in each of the vehicle axes.
- 20 Missions — Sweep from the low frequency to the high frequency to the low frequency two times in each of the vehicle axes.

## I. Shock Test

Shock pulses or spectra are stated for each specification. When two shock criteria are specified for a component, only the maximum shock spectrum should be used. Any pulse that results in a spectrum within the test tolerances at every frequency of the specified shock spectrum is acceptable. Either mechanical or ordnance shock testing is acceptable. During mechanical shock testing, the test specimen will be subjected to two shocks per mission in each axis (equivalent to one in each direction) for a total of six shocks per mission. During ordnance shock testing, the specimen will be subjected to one shock per mission, which must satisfy the applicable specifications in at least one axis.

## J. Combined Environments

Vibration, shock, and acoustic testing under various combined environments will be specified when required, by the responsible Marshall Space Flight Center (MSFC) organization.

## K. Test Tolerances

The test spectra shall be verified by narrow band spectral analysis using an analysis system that is independent from the analyzer/equalizer used to control the test. Tolerances considered acceptable are as follows:

- Vibration

Composite Root Mean Square Acceleration	±10%
Acceleration Spectral Density	+100%
(Tolerances pertain to bandwidths of 25 Hz or less)	-30%
Sinusoidal Peak Acceleration	+20%
	-10%
Sinusoidal Control Signal Maximum Harmonic Distortion	±10%
Frequency	±5%
Test Duration	+10%
	-0%

- Shock Spectrum

Spectrum Peak Acceleration	+40%
(When analyzed with a 1/3 octave shock spectrum analyzer and 5 percent damping.)	-20%

- Shock Pulse

Amplitude	+40%
	-20%
Duration	±10%
Pulse Overshoot (Water Impact)	+20%

#### L. Failure Determination

A specimen will be considered to have failed a particular test if the specimen malfunctions during or after the test, or if post-test prescribed inspection reveals structural damage. All test failures will be reported immediately to the originating agency (ED23).

#### M. Deviations From Specifications

Deviations from these specifications may be obtained only from the originating agency (ED23). All deviations will be stated in the test report.

#### N. Test Reports

A report will be submitted to the originating agency by the testing agency describing in detail the tests performed and the results of the tests. The report will include drawings, sketches, and photographs, showing in detail all measurement locations. The report will include all calibration and measured test levels and any other information pertinent to the acquisition, reduction, analysis, and interpretation of the test data. Equalization levels and durations will be included.

Progress reports will be provided to the originating agency as requested.

### SECTION III. SELECTION OF APPLICABLE VIBRATION AND SHOCK SPECIFICATIONS FOR STRUCTURALLY MOUNTED COMPONENTS

The selection of the correct qualification specification is essential in developing confidence and reliability in the component. The following general discussion should be considered before making such a selection.

A zonal technique has been used in generating and presenting the qualification specifications. Using this technique, the Space Shuttle SRB has been divided into zones and subzones (Figures 1 and 2, Appendix A) as determined by the responsible MSFC organization. Where applicable, each subzone was further divided into subzone weight ranges or major components.

Three distinct types of component and subassembly qualification specifications are presented:

- Subzones (General Specifications)
- Subzone Weight Ranges
- Specific Component Specifications

A subzone (General Specifications) pertains to all components and subassemblies mounted on a particular type of structure. These specifications are labeled "General" because they are applicable to all components and subassemblies in that subzone. General Specifications are based on the vibration environment for all structures within the subzones. Consequently, General Specifications usually result in more severe qualification specifications than weighted specifications. General specifications should be used only when Subzone Weight Ranges and Specific Component Specifications cannot be used.

Specifications for subzone weight ranges and major components have been determined wherever practical. These specifications pertain to certain items (components, subassemblies, panels, etc.) located within a specific subzone, and may be distinguished by the absence of the notation "General Specifications" and the inclusion of a letter suffix (-A, -B, etc.) in the specification number. These specifications are based on vibration environments for various types of local structures (skin, stringer, ringframe, panels, etc.).

In general, specifications for individual components are based on the component's weight, location, and mounting configuration and can be found in the appropriate subzone. Specifications for selected SRB and common ET/SRB components are included in Appendixes B and C.

The appropriate qualification specification may be determined for a particular component or subassembly by the following procedure:

- Determine if a specific component specification exists; if not:
- Identify the zone in which the component or subassembly is located;

- Within this zone determine the subzone in which the particular component or subassembly is located;
- Identify the subzone specification corresponding to the weight of the component.

## SECTION IV. ACOUSTIC TEST REQUIREMENTS AND PROCEDURES

### A. General Requirements

All structures and components requiring acoustic testing will be subjected to either broadband reverberant field or progressive wave testing. The acoustical random noise source for either type will have an approximate normal amplitude distribution. Reverberant field testing is preferred for both structures and components. However, structural panels as well as components may be tested using progressive wave facilities where this type of test is justified.

### B. Specification Selection

A zonal technique has been used in generating and presenting the qualification specifications. Using this technique, the SRB has been divided into zones and sub-zones as shown in Figures 1 and 2, Appendix A. Acoustic test specifications for each of these general zones are provided in Section VIII.

The appropriate qualification specification can be determined by identifying the zone or subzone in which the component is located.

### C. Reverberation Chamber Facilities

The test chamber will be of sufficient volume and dimensions to ensure that the insertion of test specimen will not affect the generation and maintenance of a broadband diffuse sound field above 50 Hz. Normally, the test specimen will be suspended in the center of the test chamber with soft suspension cords. The suspension system will have a fundamental frequency of less than 25 Hz.

The sound field in the proximity of each major surface of any test specimen that will be subjected to external acoustic environments will be determined by either flush mounted microphones or microphones mounted approximately 0.25 in. from the specimen surface. These microphones may serve as the control measurements. When the placement of these microphones is not feasible or will compromise the test results, at least three microphones located in the field will serve as control measurements. These microphones will not be located in close proximity to any surface within the test chamber. The control measurements, whether flush mounted or field located, will be averaged to determine the sound field.

With the specimen in the test chamber, the sound pressure level spectrum will be shaped at a level approximately 6 dB less than the specification. The time required to shape the spectrum will be minimized to avoid possible overstressing of the test specimen. After completion of the spectrum shaping, the sound pressure level will be increased to the specified value, and the test will commence. As an alternative to reducing the sound pressure level while shaping the spectrum, a dummy specimen may be positioned in the test chamber, and the spectrum shaped at the test level. When the spectrum shaping has been completed, the dummy specimen will be replaced by the test specimen, and the test will commence.



#### D. Progressive Wave Facilities

The structural panel specimens may be tested in progressive wave facilities. The test specimen will be centrally mounted in the wall of the progressive wave duct. The width of the wave duct will be of sufficient distance to ensure minimum effects on the panel response characteristics.

Components may be tested in progressive wave facilities. The specimen will be centrally located in the progressive wave duct and suspended by a system having a fundamental frequency of less than 25 Hz. The cross section of the progressive wave duct will be of sufficient area, relative to the frontal area of the test specimen, to ensure that the insertion of the test specimen will not affect the generation and maintenance of the progressive wave. The test specimen will have each major surface exposed to the sound field by orienting each major surface parallel to the progressive wave front. Each major surface will be exposed to the sound field for the full test duration.

For both types of progressive wave testing, the sound pressure level spectrum will be shaped without the test specimen in place. The uniformity of the sound field will be determined by locating at least three microphones in the proximity of the duct cross sectional plane where the test specimen will be mounted. After mounting the test specimen, the sound pressure level will be reestablished, and the test will commence. Alternatively, for structural panel specimens, the sound pressure level may be shaped at a level 6 dB less than the specification. The time required to shape the spectrum will be minimized to avoid inadvertent overstressing.

#### E. Tolerances

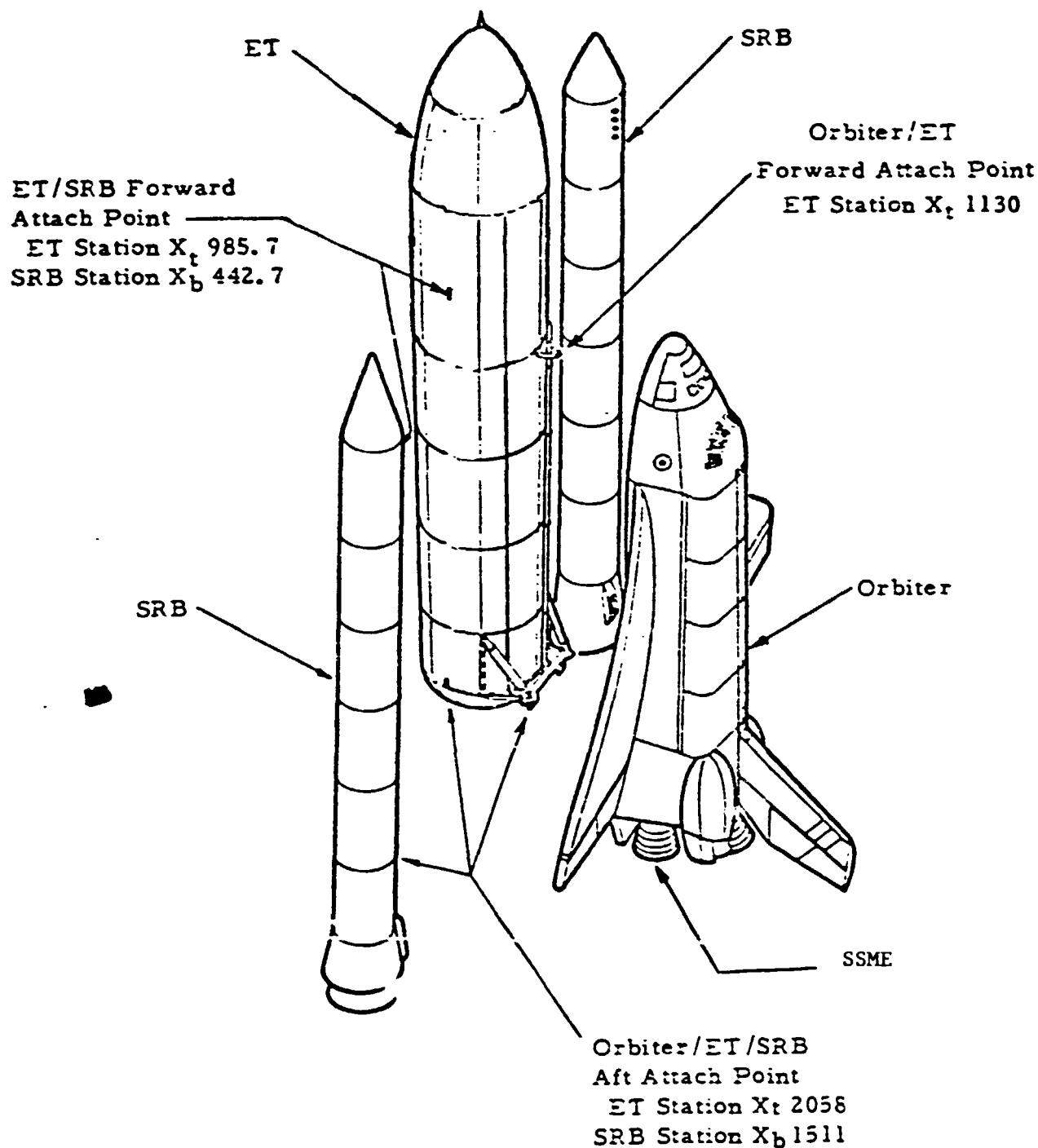
The test time will be within plus 10 to minus 5 percent of the time stated in the specification. The overall sound pressure level and the individual 1/3 octave band sound pressure levels will be within plus 2 to minus 2 dB of the specification. The sound pressure level tolerance applies to the frequency range of 50 through 10,000 Hz.

## SECTION V. ACCEPTANCE TEST REQUIREMENTS AND PROCEDURES

The requirement to do acceptance testing will be established for each program by the project manager. This document does not establish the requirement to do acceptance testing; however, it does give the acceptance test levels to be used if acceptance testing is required. If acceptance testing is required on the flight hardware, it will also be required on the qualification hardware. Acceptance test levels will be 6 dB below the qualification composite level.

Test procedures and tolerances will be the same as specified in the appropriate sections of this document.

SECTION VI. SPACE SHUTTLE GENERAL CONFIGURATION



## ABBREVIATIONS

c/o	cutoff
DA	double amplitude
DA Disp	double amplitude displacement
dB	decibels
dB/oct	decibels per octave
DNA	does not apply
ET	vehicle external tank
FWC	filament wound case
FPL	full power level
g	gravitational constant
$g^2/\text{Hz}$	acceleration spectral density
grms	root mean square acceleration
g's peak	peak acceleration
Hz	Hertz (cycles per second)
MPL	minimum power level
MSFC	Marshall Space Flight Center
OA SPL	overall sound pressure level
Max Q	time of maximum dynamic pressure
RPL	rated power level
RPM	revolutions per minute
rms	root mean square
SPL	sound pressure level
SRB	solid rocket booster
TBD	to be determined
TVC	thrust vector control

# ABBREVIATIONS (Concluded)

$X_t$	X axis of ET
$Y_t$	Y axis of ET
$Z_t$	Z axis of ET

**PART II**

**VIBRATION, ACOUSTIC, AND SHOCK**

**DESIGN AND TEST CRITERIA**

**FOR**

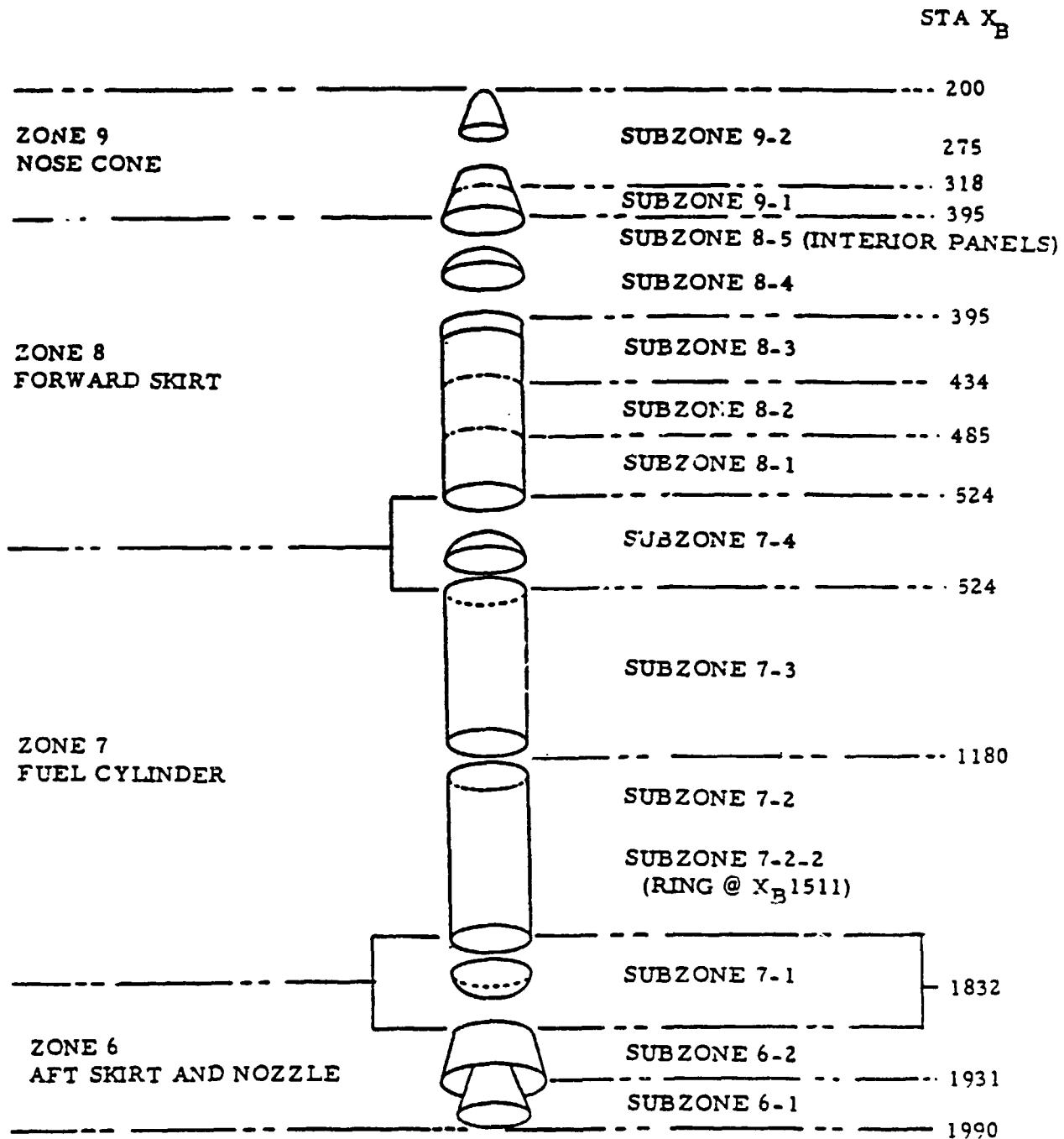
**COMPONENTS ON THE SRB**

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# SECTION I. SRB ZONES





## SECTION II. VIBRATION SPECIFICATIONS

Zone 6           SRB Nozzle and Aft Skirt

Subzone 6-1    SRB Nozzle — Stations 1990-1830 (General Specifications)

Same as Subzone 6-1-A below.

Subzone 6-1-A Input to Components Mounted on the SRB Nozzle

### 1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.0095  $g^2/Hz$   
20 - 800 Hz @ +3 dB/oct  
800 - 1200 Hz @ 0.38  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.14  $g^2/Hz$

Composite = 21.8  $g_{rms}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 Hz @ 0.038  $g^2/Hz$   
20 - 800 Hz @ +3 dB/oct  
800 - 1200 Hz @ 1.50  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.55  $g^2/Hz$

Composite = 43.6  $g_{rms}$

6-1-A (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 50 Hz @  $0.27 \text{ g}^2/\text{Hz}$   
50 - 120 Hz @ +12 dB/oct  
120 - 200 Hz @  $9.12 \text{ g}^2/\text{Hz}$   
200 - 650 Hz @ -15 dB/oct  
650 - 1400 Hz @  $0.031 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $38.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 90 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
90 - 130 Hz @ +6 dB/oct  
130 - 180 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
180 - 280 Hz @ -9 dB/oct  
280 - 540 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
540 - 800 Hz @ +12 dB/oct  
800 - 1400 Hz @  $1.00 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.33 \text{ g}^2/\text{Hz}$

Composite =  $36.0 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables II, IX and X.

\* Design Criteria Only

Subzone 6-2 SRB AFT Skirt — Stations 1930-1837 (General Specifications)

Same as Subzone 6-2-A below.

Subzone 6-2-A Input to Components Mounted on the SRB Aft Skirt.  
Weight of Component <25 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 110 Hz @ +6 dB/oct.  
110 - 200 Hz @ 0.38  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0080  $g^2/Hz$

Composite = 10.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.011  $g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 53 Hz @ 0.025  $g^2/Hz$   
53 - 150 Hz @ +6 dB/oct  
150 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.032  $g^2/Hz$

Composite = 15.4  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 100 Hz @ +6 dB/oct  
100 - 200 Hz @ 0.25  $g^2/Hz$   
200 - 280 Hz @ -12 dB/oct  
280 - 1200 Hz @ 0.060  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.036  $g^2/Hz$

Composite = 11.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 250 Hz @ +3 dB/oct  
250 - 1000 Hz @ 0.20  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.10  $g^2/Hz$

Composite = 17.7  $g_{rms}$

# 6-2-A (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.21  $g^2/Hz$   
 20 - 100 Hz @ +2 dB/oct  
 100 - 200 Hz @ 0.60  $g^2/Hz$   
 200 - 335 Hz @ -9 dB/oct  
 335 - 1000 Hz @ 0.13  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.032  $g^2/Hz$

Composite = 16.8  $g_{rms}$

### Long. and Tang. Axes

20 - 82 Hz @ 0.18  $g^2/Hz$   
 82 - 430 Hz @ +2 dB/oct  
 430 - 975 Hz @ 0.54  $g^2/Hz$   
 975 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.13  $g^2/Hz$

Composite = 26.6  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
 20 - 110 Hz @ +6 dB/oct  
 110 - 200 Hz @ 1.50  $g^2/Hz$   
 200 - 395 Hz @ -9 dB/oct  
 395 - 800 Hz @ 0.20  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.032  $g^2/Hz$

Composite = 21.9  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.044  $g^2/Hz$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 53 Hz @ 0.10  $g^2/Hz$   
 53 - 150 Hz @ +6 dB/oct  
 150 - 800 Hz @ 0.80  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.13  $g^2/Hz$

Composite = 30.8  $g_{rms}$

## 5. Vehicle Dynamics Criteria

### Longitudinal Axis

2.5 - 5 Hz @ 0.7 G's peak\*  
 5 - 10 Hz @ 0.7 G's peak  
 10 - 40 Hz @ 1.0 G's peak

### Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
 5 - 10 Hz @ 0.5 G's peak  
 10 - 40 Hz @ 3.7 G's peak

## 6. Shock Test Criteria (2 shocks/axis)

See Tables III, IX and X.

\* Design Criteria Only

Subzone 6-2-B Input to Components Mounted on the SRB Aft Skirt.  
Weight of Component  $\geq 25$  but  $< 75$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
 20 - 80 Hz @ +6 dB/oct  
 80 - 200 Hz @ 0.21  $g^2/Hz$   
 200 - 395 Hz @ -9 dB/oct  
 395 - 800 Hz @ 0.028  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0045  $g^2/Hz$

Composite = 8.4  $g_{rms}$

Long. and Tang. Axes

20 - 39 Hz @ 0.014  $g^2/Hz$   
 39 - 110 Hz @ +6 dB/oct  
 110 - 800 Hz @ 0.11  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.018  $g^2/Hz$

Composite = 11.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
 20 - 75 Hz @ +6 dB/oct  
 75 - 200 Hz @ 0.14  $g^2/Hz$   
 200 - 280 Hz @ -12 dB/oct  
 280 - 1200 Hz @ 0.033  $g^2/Hz$   
 1200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.020  $g^2/Hz$

Composite = 8.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 140 Hz @ +3 dB/oct  
 140 - 1000 Hz @ 0.11  $g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.055  $g^2/Hz$

Composite = 13.4  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.21  $g^2/Hz$   
 20 - 40 Hz @ +2 dB/oct  
 40 - 200 Hz @ 0.33  $g^2/Hz$   
 200 - 335 Hz @ -9 dB/oct  
 335 - 1000 Hz @ 0.070  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.018  $g^2/Hz$

Composite = 12.7  $g_{rms}$

Long. and Tang. Axes

20 - 82 Hz @ 0.10  $g^2/Hz$   
 82 - 430 Hz @ +2 dB/oct  
 430 - 975 Hz @ 0.30  $g^2/Hz$   
 975 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.072  $g^2/Hz$

Composite = 19.8  $g_{rms}$

Subzone 6-2-C Input to Components Mounted on the SRB Aft Skirt.  
Weight of Component  $\geq 75$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +6 dB/oct  
 60 - 200 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 200 - 395 Hz @ -9 dB/oct  
 395 - 800 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0024 \text{ g}^2/\text{Hz}$

Composite =  $6.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 29 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 29 - 82 Hz @ +6 dB/oct  
 82 - 800 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0098 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 20 - 55 Hz @ +6 dB/oct  
 55 - 200 Hz @  $0.077 \text{ g}^2/\text{Hz}$   
 200 - 280 Hz @ -12 dB/oct  
 280 - 1200 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
 1200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 20 - 75 Hz @ +3 dB/oct  
 75 - 1000 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $10.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 200 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 200 - 335 Hz @ -9 dB/oct  
 335 - 1000 Hz @  $0.039 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0098 \text{ g}^2/\text{Hz}$

Composite =  $9.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 82 Hz @  $0.054 \text{ g}^2/\text{Hz}$   
 82 - 430 Hz @ +2 dB/oct  
 430 - 975 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
 975 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.039 \text{ g}^2/\text{Hz}$

Composite =  $14.5 \text{ g}_{\text{rms}}$

6-2-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 200 Hz @ 0.45  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.060  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0095  $g^2/Hz$

Composite = 12.6  $g_{rms}$

Long. and Tang. Axes

20 - 29 Hz @ 0.030  $g^2/Hz$   
29 - 82 Hz @ +6 dB/oct  
82 - 800 Hz @ 0.24  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.039  $g^2/Hz$

Composite = 17.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables III, IX and X.

\* Design Criteria Only

Zone 7            SRB Fuel Cylinder and Bulkheads.

Subzone 7-1      SRB Aft Fuel Bulkhead — Stations 1875-1818 (General Specifications)

Same as Subzone 7-1-A below.

Subzone 7-1-A    Input to Components Mounted on the SRB Aft Fuel Bulkhead.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 - 73 Hz @ 0.00017  $g^2/Hz$   
73 - 170 Hz @ +15 dB/oct  
170 - 2000 Hz @ 0.012  $g^2/Hz$

Composite = 4.8  $g_{rms}$

Directions B and C

20 - 50 Hz @ 0.0050  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.015  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00095  $g^2/Hz$

Composite = 3.4  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @ 0.020  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Direction A

20 - 73 Hz @ 0.00070  $g^2/Hz$   
73 - 170 Hz @ +15 dB/oct  
170 - 2000 Hz @ 0.050  $g^2/Hz$

Composite = 9.6  $g_{rms}$

Directions B and C

20 - 240 Hz @ 0.00094  $g^2/Hz$   
240 - 700 Hz @ +9 dB/oct  
700 - 1200 Hz @ 0.024  $g^2/Hz$   
1200 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0051  $g^2/Hz$

Composite = 5.0  $g_{rms}$



7-1-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axis

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 3.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX, and X

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 7-2 SRB Aft Fuel Cylinder — Stations 1837-1180.

Subzone 7-2-1 SRB Aft Fuel Cylinder — Stations 1837-1180 (General Specifications)

Same as Subzone 7-2-1-A below.

Subzone 7-2-1-A Input to Components Mounted on the SRB Aft Fuel Cylinder.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0090  $g^2/Hz$   
20 - 180 Hz @ +6 dB/oct  
180 - 280 Hz @ 0.78  $g^2/Hz$   
280 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 17.6  $g_{rms}$

Long. and Tang. Axes

20 - 50 Hz @ 0.0050  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.015  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00095  $g^2/Hz$

Composite = 3.4  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @ 0.020  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.036  $g^2/Hz$   
20 - 180 Hz @ +6 dB/oct  
180 - 280 Hz @ 3.13  $g^2/Hz$   
280 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.059  $g^2/Hz$

Composite = 35.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0039  $g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 275 Hz @ 0.063  $g^2/Hz$   
275 - 560 Hz @ -9 dB/oct  
560 - 2000 Hz @ 0.0075  $g^2/Hz$

Composite = 5.6  $g_{rms}$

7-2-1-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX and X.

\* Design Criteria Only

Subzone 7-2-1-A Input to Components Mounted on the SRB Aft FWC Segments  
(Stations 1837 - 1180)

1. Acceptance Test Criteria (1 minute/axis)

Radial Axis

20 Hz @ 0.01  $g^2/Hz$   
20 - 140 Hz @ +5 dB/oct  
140 - 280 Hz @ 0.9  $g^2/Hz$   
280 - 2000 Hz @ -8 dB/oct  
2000 Hz @ 0.0011  $g^2/Hz$

Composite = 8.9 grms

Long. and Tang. Axes

20 - 50 Hz @ 0.012  $g^2/Hz$   
50 - 220 Hz @ +3 dB/oct  
220 - 500 Hz @ 0.05  $g^2/Hz$   
500 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.0022  $g^2/Hz$

Composite = 6.0 grms

2. Flight Random Vibration Criteria (4 minutes plus 2 minutes/mission in each axis)

All Axes

20 - 50 Hz @ 0.047  $g^2/Hz$   
50 - 220 Hz @ +3 dB/oct  
220 - 500 Hz @ 0.20  $g^2/Hz$   
500 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.009  $g^2/Hz$

Composite = 12.0 grms

3. Reentry Random Vibration Criteria (60 seconds plus 30 seconds/mission in each axis)

Radial Axis

20 Hz @ 0.04  $g^2/Hz$   
20 - 140 Hz @ +5 dB/oct  
140 - 280 Hz @ 0.9  $g^2/Hz$   
280 - 2000 Hz @ -8 dB/oct  
2000 Hz @ 0.0044  $g^2/oct$

Composite = 17.8 grms

Long. and Tang. Axes

20 Hz @ 0.0039  $g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 275 Hz @ 0.063  $g^2/Hz$   
275 - 560 Hz @ -9 dB/oct  
560 - 2000 Hz @ 0.0075  $g^2/oct$

Composite = 5.6 grms

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 g's peak\*  
5 - 40 Hz @ 1.0 g's peak

Lateral Axes

2 - 5 Hz @ 1.7 g's peak\*  
5 - 10 Hz @ 0.6 g's peak  
10 - 40 Hz @ 1.7 g's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX, and X.

\*Design criteria only

Subzone 7-2-2 SRB/ET Attach Ring at Station 1511 (General Specifications)

Same as Subzone 7-2-2-A below.

Subzone 7-2-2-A Input to Components on the SRB/ET Attach Ring.

1. Acceptance Test Criteria (1 min/axis)

Radial and Tangential Axes

20 Hz @ 0.0025  $g^2/Hz$   
20 - 120 Hz @ +6 dB/oct  
120 - 200 Hz @ 0.095  $g^2/Hz$   
200 - 375 Hz @ -9 dB/oct  
375 - 2000 Hz @ 0.015  $g^2/Hz$

Composite = 6.4  $g_{rms}$

Longitudinal Axis

20 - 105 Hz @ 0.030  $g^2/Hz$   
105 - 180 Hz @ +9 dB/oct  
180 - 1000 Hz @ 0.16  $g^2/Hz$   
1000 - 1125 Hz @ +12 dB/oct  
1125 - 1400 Hz @ 0.25  $g^2/Hz$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.085  $g^2/Hz$

Composite = 17.9  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial and Tangential Axes

20 - 50 Hz @ 0.020  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

Longitudinal Axis

20 - 85 Hz @ 0.014  $g^2/Hz$   
85 - 220 Hz @ +6 dB/oct  
220 - 900 Hz @ 0.090  $g^2/Hz$   
900 - 1175 Hz @ +9 dB/oct  
1175 - 1500 Hz @ 0.20  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.11  $g^2/Hz$

Composite = 15.7  $g_{rms}$

7-2-2-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial and Tangential Axes

20 - 28 Hz @ 0.020  $g^2/Hz$   
 28 - 120 Hz @ +6 dB/oct  
 120 - 200 Hz @ 0.38  $g^2/Hz$   
 200 - 375 Hz @ -9 dB/oct  
 375 - 1200 Hz @ 0.060  $g^2/Hz$   
 1200 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.013  $g^2/Hz$

Composite = 12.1  $g_{rms}$

Longitudinal Axis

20 - 105 Hz @ 0.12  $g^2/Hz$   
 105 - 157 Hz @ +9 dB/oct  
 157 - 1400 Hz @ 0.40  $g^2/Hz$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.14  $g^2/Hz$

Composite = 25.7  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial and Tangential Axes

20 Hz @ 0.010  $g^2/Hz$   
 20 - 120 Hz @ +6 dB/oct  
 120 - 200 Hz @ 0.38  $g^2/Hz$   
 200 - 375 Hz @ -9 dB/oct  
 375 - 2000 Hz @ 0.060  $g^2/Hz$

Composite = 12.9  $g_{rms}$

Longitudinal Axis

20 - 105 Hz @ 0.12  $g^2/Hz$   
 105 - 180 Hz @ +9 dB/oct  
 180 - 1000 Hz @ 0.63  $g^2/Hz$   
 1000 - 1125 Hz @ +12 dB/oct  
 1125 - 1400 Hz @ 1.00  $g^2/Hz$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.34  $g^2/Hz$

Composite = 35.8  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX and X.

\* Design Criteria Only

Subzone 7-3      SRB Forward Fuel Cylinder — Stations 1180-524 (General Specifications)

Same as Subzone 7-3-A below.

Subzone 7-3-A      Input to Components on the SRB Forward Fuel Cylinder.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0014  $g^2/Hz$   
20 - 150 Hz @ +6 dB/oct  
150 - 280 Hz @ 0.080  $g^2/Hz$   
280 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.00012  $g^2/Hz$

Composite = 4.8  $g_{rms}$

Long. and Tang. Axes

20 - 50 Hz @ 0.0050  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.015  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00095  $g^2/Hz$

Composite = 3.4  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @ 0.20  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0055  $g^2/Hz$   
20 - 150 Hz @ +6 dB/oct  
150 - 280 Hz @ 0.31  $g^2/Hz$   
280 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.00050  $g^2/Hz$

Composite = 9.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0016  $g^2/Hz$   
20 - 80 Hz @ +9 dB/oct  
80 - 200 Hz @ 0.11  $g^2/Hz$   
200 - 800 Hz @ -10 dB/oct  
800 - 2000 Hz @ 0.0053  $g^2/Hz$

Composite = 5.3  $g_{rms}$

7-3-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX and X.

\* Design Criteria Only



Subzone 7-3-A Input to Components on the SRB Forward FWC Segments  
(Stations 1180 - 524)

1. Acceptance Test Criteria (1 min/axis)

20 - 50 Hz @ 0.012  $g^2/Hz$   
50 - 220 Hz @ +3 dB/oct  
220 - 500 Hz @ 0.05  $g^2/Hz$   
500 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.0022  $g^2/Hz$

Composite = 6.0  $g_{rms}$

2. Flight Random Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @ 0.047  $g^2/Hz$   
50 - 220 Hz @ +3 dB/oct  
220 - 500 Hz @ 0.20  $g^2/Hz$   
500 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.009  $g^2/Hz$

Composite - 12.0  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.01  $g^2/Hz$   
20 - 100 Hz @ +5.5 dB/oct  
100 - 310 Hz @ 0.2  $g^2/Hz$   
310 - 2000 Hz @ -8.5 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 9.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.003  $g^2/Hz$   
20 - 60 Hz @ +8 dB/oct  
60 - 400 Hz @ 0.06  $g^2/Hz$   
400 - 2000 Hz @ -3.5 dB/oct  
2000 Hz @ 0.01  $g^2/Hz$

Composite = 7.5  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX, and X.

\* Design Criteria Only

Subzone 7-4      SRB Forward Fuel Bulkhead -- Stations 531-486 (General Specifications)

Same as Subzone 7-4-A below.

Subzone 7-4-A      Input to Components on the SRB Forward Fuel Bulkhead.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 - 55 Hz @  $0.00018 \text{ g}^2/\text{Hz}$   
55 - 200 Hz @ +12 dB/oct  
200 - 300 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.00095 \text{ g}^2/\text{Hz}$

Composite =  $4.7 \text{ g}_{\text{rms}}$

Directions B and C

20 - 50 Hz @  $0.0050 \text{ g}^2/\text{Hz}$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.00095 \text{ g}^2/\text{Hz}$

Composite =  $3.4 \text{ g}_{\text{rms}}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0038 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Direction A

20 - 55 Hz @  $0.00070 \text{ g}^2/\text{Hz}$   
55 - 200 Hz @ +12 dB/oct  
200 - 300 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $9.5 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.0012 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @  $0.0047 \text{ g}^2/\text{Hz}$   
300 - 450 Hz @ +12 dB/oct  
450 - 1000 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0030 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

7-4-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Tables IV, IX and X.

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Portions of the following section (subzone 8-1) were updated as a result of the IS-2 Ames (3.5%) Model Wind Tunnel Tests. Pages 35 through 45 provide revised Boost Random Vibration Criteria, additional subzones, and revised Acceptance Test Criteria where dictated by changes in the Boost Random Criteria. These pages should be used in conjunction with pages 21 through 34 for determining Design and Test Criteria.

## Zone 8

## SRB Forward Skirt

## Subzone 8-1

## SRB Forward Skirt — Stations 524-485 (General Specifications)

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

	20 Hz @ 0.0025 $g^2/Hz$
20 -	60 Hz @ +3 dB/oct
	60 Hz @ 0.0075 $g^2/Hz$
60 -	250 Hz @ +6 dB/oct
250 -	600 Hz @ 0.13 $g^2/Hz$
600 -	2000 Hz @ -9 dB/oct
	2000 Hz @ 0.0033 $g^2/Hz$

Composite = 9.4  $g_{rms}$ 

## Long. and Tang. Axes

	20 Hz @ 0.0040 $g^2/Hz$
20 -	100 Hz @ +3 dB/oct
100 -	1000 Hz @ 0.020 $g^2/Hz$
1000 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.0050 $g^2/Hz$

Composite = 5.4  $g_{rms}$ 

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Radial Axis

	20 Hz @ 0.0072 $g^2/Hz$
20 -	55 Hz @ +3 dB/oct
	55 Hz @ 0.020 $g^2/Hz$
55 -	200 Hz @ +6 dB/oct
200 -	600 Hz @ 0.25 $g^2/Hz$
600 -	2000 Hz @ -9 dB/oct
	2000 Hz @ 0.0064 $g^2/Hz$

Composite = 13.6  $g_{rms}$ 

## Long. and Tang. Axes

	20 Hz @ 0.012 $g^2/Hz$
20 -	73 Hz @ +3 dB/oct
	73 Hz @ 0.044 $g^2/Hz$
73 -	100 Hz @ +6 dB/oct
100 -	150 Hz @ 0.083 $g^2/Hz$
150 -	190 Hz @ -9 dB/oct
190 -	1000 Hz @ 0.040 $g^2/Hz$
1000 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.010 $g^2/Hz$

Composite = 5.4  $g_{rms}$

# 8-1 (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
 20 - 60 Hz @ +3 dB/oct  
 60 Hz @ 0.030  $g^2/Hz$   
 60 - 250 Hz @ +6 dB/oct  
 250 - 600 Hz @ 0.50  $g^2/Hz$   
 600 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.013  $g^2/Hz$

Composite = 18.8  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 1000 Hz @ 0.080  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.020  $g^2/Hz$

Composite = 10.8  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
 20 - 120 Hz @ +3 dB/oct  
 120 - 200 Hz @ 0.70  $g^2/Hz$   
 200 - 235 Hz @ -6 dB/oct  
 235 - 500 Hz @ 0.50  $g^2/Hz$   
 500 - 1000 Hz @ -12 dB/oct  
 1000 Hz @ 0.032  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0041  $g^2/Hz$

Composite = 18.3  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 150 Hz @ 0.30  $g^2/Hz$   
 150 - 235 Hz @ -12 dB/oct  
 235 - 800 Hz @ 0.050  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0080  $g^2/Hz$

Composite = 9.6  $g_{rms}$

## 5. Vehicle Dynamics Criteria

### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
 5 - 10 Hz @ 0.7 G's peak  
 10 - 40 Hz @ 1.0 G's peak

### Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
 5 - 10 Hz @ 0.5 G's peak  
 10 - 40 Hz @ 4.3 G's peak

## 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-1-1 SRB Forward Skirt Skin and Stringers — Stations 524-485  
(General Specifications)

Same as Subzone 8-1-1-A below.

Subzone 8-1-1-A Input to Components Mounted on the SRB Forward Skirt Skin or Stringers — Stations 524-485. Weight of Component <30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.030  $g^2/\text{Hz}$   
20 - 120 Hz @ +3 dB/oct  
120 - 200 Hz @ 0.18  $g^2/\text{Hz}$   
200 - 235 Hz @ -6 dB/oct  
235 - 500 Hz @ 0.12  $g^2/\text{Hz}$   
500 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00050  $g^2/\text{Hz}$

Composite = 9.1  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.0078  $g^2/\text{Hz}$   
20 - 90 Hz @ +3 dB/oct  
90 - 150 Hz @ 0.035  $g^2/\text{Hz}$   
150 - 575 Hz @ -12 dB/oct  
575 - 1100 Hz @ 0.00062  $g^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00019  $g^2/\text{Hz}$

Composite = 2.5  $g_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0025  $g^2/\text{Hz}$   
20 - 200 Hz @ +6 dB/oct  
200 - 600 Hz @ 0.25  $g^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0020  $g^2/\text{Hz}$

Composite = 12.9  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.0033  $g^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @ 0.083  $g^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @ 0.0090  $g^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0045  $g^2/\text{Hz}$

Composite = 5.0  $g_{\text{rms}}$

### 8-1-1-A (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec mission in each axis)

##### Radial Axis

20 Hz @ 0.0033  $g^2/Hz$   
 20 - 250 Hz @ +6 dB/oct  
 250 - 600 Hz @ 0.50  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0041  $g^2/Hz$

Composite = 17.7  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.0026  $g^2/Hz$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @ 0.066  $g^2/Hz$   
 150 - 380 Hz @ -6 dB/oct  
 380 - 1000 Hz @ 0.010  $g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0051  $g^2/Hz$

Composite = 5.0  $g_{rms}$

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
 20 - 120 Hz @ +3 dB/oct  
 120 - 200 Hz @ 0.70  $g^2/Hz$   
 200 - 235 Hz @ -6 dB/oct  
 235 - 500 Hz @ 0.50  $g^2/Hz$   
 500 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0020  $g^2/Hz$

Composite = 18.2  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 90 Hz @ +3 dB/oct  
 90 - 150 Hz @ 0.14  $g^2/Hz$   
 150 - 575 Hz @ -12 dB/oct  
 575 - 1100 Hz @ 0.0025  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00076  $g^2/Hz$

Composite = 5.0  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only



Subzone 8-1-1-B Input to Components Mounted on the SRB Forward Skirt Skin or Stringers — Stations 524-485. Weight of Component  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +3 dB/oct  
 60 - 200 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 200 - 235 Hz @ -6 dB/oct  
 235 - 500 Hz @  $0.062 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00025 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0078 \text{ g}^2/\text{Hz}$   
 20 - 90 Hz @ +3 dB/oct  
 90 - 150 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
 150 - 575 Hz @ -12 dB/oct  
 575 - 1100 Hz @  $0.00062 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.00019 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
 20 - 140 Hz @ +6 dB/oct  
 140 - 600 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $9.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
 150 - 310 Hz @ -9 dB/oct  
 310 - 1000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

# 8-1-1-B (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.0033  $g^2/Hz$   
 20 - 175 Hz @ +6 dB/oct  
 175 - 600 Hz @ 0.25  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0021  $g^2/Hz$

Composite = 13.0  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.0026  $g^2/Hz$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @ 0.060  $g^2/Hz$   
 150 - 380 Hz @ -6 dB/oct  
 380 - 1000 Hz @ 0.010  $g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0051  $g^2/Hz$

Composite = 5.0  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
 20 - 60 Hz @ +3 dB/oct  
 60 - 200 Hz @ 0.35  $g^2/Hz$   
 200 - 235 Hz @ -6 dB/oct  
 235 - 500 Hz @ 0.25  $g^2/Hz$   
 500 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0010  $g^2/Hz$

Composite = 13.3  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 90 Hz @ +3 dB/oct  
 90 - 150 Hz @ 0.14  $g^2/Hz$   
 150 - 575 Hz @ -12 dB/oct  
 575 - 1100 Hz @ 0.0025  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00076  $g^2/Hz$

Composite = 5.0  $g_{rms}$

## 5. Vehicle Dynamics Criteria

### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 20 - 40 Hz @ 1.7 G's peak

## 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-1-1-C Input to Components Mounted on the SRB Forward Skirt Skin or Stringers - Stations 524-485. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
20 - 38 Hz @ +3 dB/oct  
38 - 200 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
200 - 235 Hz @ -6 dB/oct  
235 - 500 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00016 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0078 \text{ g}^2/\text{Hz}$   
20 - 90 Hz @ +3 dB/oct  
90 - 150 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
150 - 575 Hz @ -12 dB/oct  
575 - 1100 Hz @  $0.00062 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.00019 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 115 Hz @ +6 dB/oct  
115 - 600 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00065 \text{ g}^2/\text{Hz}$

Composite =  $7.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

8-1-1-C (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0033  $g^2/Hz$   
 20 - 140 Hz @ +6 dB/oct  
 140 - 600 Hz @ 0.16  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0013  $g^2/Hz$

Composite = 10.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0026  $g^2/Hz$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @ 0.066  $g^2/Hz$   
 150 - 380 Hz @ -6 dB/oct  
 380 - 1000 Hz @ 0.010  $g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0051  $g^2/Hz$

Composite = 5.0  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
 20 - 38 Hz @ +3 dB/oct  
 38 - 200 Hz @ 0.22  $g^2/Hz$   
 200 - 235 Hz @ -6 dB/oct  
 235 - 500 Hz @ 0.16  $g^2/Hz$   
 500 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.00063  $g^2/Hz$

Composite = 10.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 90 Hz @ +3 dB/oct  
 90 - 150 Hz @ 0.14  $g^2/Hz$   
 150 - 575 Hz @ -12 dB/oct  
 575 - 1100 Hz @ 0.0025  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00076  $g^2/Hz$

Composite = 5.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-1-2      SRB Forward Skirt Rings — Stations 524-485 (General Specifications)

Same as Subzone 8-1-2-A below.

Subzone 8-1-2-A      Input to Components Mounted on the SRB Forward Skirt Rings — Stations 524-485.      Weight of Component < 40 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0032  $g^2/Hz$

Composite = 6.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.020  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 5.4  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 310 Hz @ 0.054  $g^2/Hz$   
310 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.090  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0058  $g^2/Hz$

Composite = 9.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.060  $g^2/Hz$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @ 0.040  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 7.8  $g_{rms}$

8-1-2-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite = 13.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.080  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 10.8  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 200 Hz @ 0.25  $g^2/Hz$   
200 - 260 Hz @ -6 dB/oct  
260 - 600 Hz @ 0.15  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0041  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.30  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0080  $g^2/Hz$

Composite = 9.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-1-2-B Input to Components Mounted on the SRB Forward Skirt Rings -  
Stations 524-485. Weight of Component  $\geq 40$  but  $< 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
 20 - 200 Hz @ +3 dB/oct  
 200 - 800 Hz @ 0.025  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0016  $g^2/Hz$

Composite = 5.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 1000 Hz @ 0.010  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0025  $g^2/Hz$

Composite = 3.8  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
 20 - 75 Hz @ +3 dB/oct  
 75 - 220 Hz @ 0.027  $g^2/Hz$   
 220 - 280 Hz @ +6 dB/oct  
 280 - 800 Hz @ 0.045  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0030  $g^2/Hz$

Composite = 6.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 150 Hz @ 0.030  $g^2/Hz$   
 150 - 180 Hz @ -6 dB/oct  
 180 - 1000 Hz @ 0.020  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0050  $g^2/Hz$

Composite = 5.5  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
 20 - 200 Hz @ +3 dB/oct  
 200 - 800 Hz @ 0.10  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0065  $g^2/Hz$

Composite = 10.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 1000 Hz @ 0.040  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 7.7  $g_{rms}$

8-1-2-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 52 Hz @ +3 dB/oct  
52 - 200 Hz @ 0.13  $g^2/Hz$   
200 - 260 Hz @ -6 dB/oct  
260 - 600 Hz @ 0.075  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0021  $g^2/Hz$

Composite = 8.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 150 Hz @ 0.15  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.025  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0040  $g^2/Hz$

Composite = 7.1  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only



Subzone 8-1-2-C Input to Components Mounted on the SRB Forward Skirt Rings -  
Stations 524-485. Weight of Component  $\geq 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 130 Hz @ +3 dB/oct  
130 - 800 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $4.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0040 \text{ g}^2/\text{Hz}$   
20 - 33 Hz @ +3 dB/oct  
33 - 1000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0016 \text{ g}^2/\text{Hz}$

Composite =  $3.1 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0072 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 180 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
180 - 230 Hz @ +6 dB/oct  
230 - 800 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0020 \text{ g}^2/\text{Hz}$

Composite =  $5.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +3 dB/oct  
34 - 150 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0033 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
20 - 130 Hz @ +3 dB/oct  
120 - 800 Hz @  $0.065 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0042 \text{ g}^2/\text{Hz}$

Composite =  $8.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
20 - 33 Hz @ +3 dB/oct  
33 - 1000 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$

Composite =  $6.2 \text{ g}_{\text{rms}}$

8-1-2-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission i. each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 200 Hz @ 0.075  $g^2/Hz$   
200 - 245 Hz @ -6 dB/oct  
245 - 600 Hz @ 0.050  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0014  $g^2/Hz$

Composite = 6.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.017  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0028  $g^2/Hz$

Composite = 5.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Zone 8 - SRB Forward Skirt

Subzone 8-1 SRB Forward Skirt — Stations 524-485 (General Specifications)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.030  $g^2/Hz$   
20 - 155 Hz @ +3 dB/oct  
155 - 320 Hz @ 0.22  $g^2/Hz$   
320 - 350 Hz @ -9 dB/oct  
350 - 550 Hz @ 0.17  $g^2/Hz$   
550 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 11.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.015  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @ 0.075  $g^2/Hz$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @ 0.025  $g^2/Hz$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 6.6  $g_{rms}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
20 - 155 Hz @ +3 dB/oct  
155 - 320 Hz @ 0.90  $g^2/Hz$   
320 - 350 Hz @ -9 dB/oct  
350 - 550 Hz @ 0.70  $g^2/Hz$   
550 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 23.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @ 0.30  $g^2/Hz$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @ 0.10  $g^2/Hz$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 13.3  $g_{rms}$

Subzone 8-1-1 SRB Forward Skirt — Stations 524-485 —  $\pm 45^\circ$  from Y-Axis  
Adjacent to ET (General Specifications)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.030  $g^2/Hz$   
20 - 155 Hz @ +3 dB/oct  
155 - 320 Hz @ 0.22  $g^2/Hz$   
320 - 350 Hz @ -9 dB/oct  
350 - 550 Hz @ 0.17  $g^2/Hz$   
550 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0010  $g^2/Hz$

Composite = 11.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0077  $g^2/Hz$   
20 - 115 Hz @ +3 dB/oct  
115 - 170 Hz @ 0.045  $g^2/Hz$   
170 - 400 Hz @ -9 dB/oct  
400 - 700 Hz @ 0.0035  $g^2/Hz$   
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0012  $g^2/Hz$

Composite = 3.4  $g_{rms}$

Subzone 8-1-1 (Cont.)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
20 - 155 Hz @ +3 dB/oct  
155 - 320 Hz @ 0.90  $g^2/Hz$   
320 - 350 Hz @ -9 dB/oct  
350 - 550 Hz @ 0.70  $g^2/Hz$   
550 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0041  $g^2/Hz$

Composite = 22.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
20 - 115 Hz @ +3 dB/oct  
115 - 170 Hz @ 0.18  $g^2/Hz$   
170 - 400 Hz @ -9 dB/oct  
400 - 700 Hz @ 0.014  $g^2/Hz$   
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0051  $g^2/Hz$

Composite - 6.9  $g_{rms}$

Subzone 8-1-1-1 SRB Forward Skirt Skin and Stringers — Stations 524-485 —  
 $\pm 135^\circ$  from Y-Axis Opposite the ET (General Specifications)

Same as Subzone 8-1-1-1-A below.

Subzone 8-1-1-1-A Input to Components Mounted on the SRB Forward Skirt Skin  
and Stringers — Stations 524-485 —  $\pm 135^\circ$  from Y-Axis Opposite  
the ET. Weight of Component <30 lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 23)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 24)

Subzone 8-1-1-1-B Input to Components Mounted on the SRB Forward Skirt Skin and Stringers — Stations 524-485 —  $\pm 135^\circ$  from Y-Axis opposite the ET. Weight of Component  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 25)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 26)

Subzone 8-1-1-1-C Input to Components Mounted on the SRB Forward Skirt Skin and Stringers — Stations 524-485 —  $\pm 135^\circ$  from Y-Axis Opposite the ET. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 27)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 28)

Subzone 8-1-1-2 SRB Forward Skirt Skin and Stringers — Stations 524-485 —  $\pm 45^\circ$  from Y-Axis Adjacent to ET (General Specifications)

Same as Subzone 8-1-1-2-A below

Subzone 8-1-1-2-A Input to Components Mounted on the SRB Forward Skirt Skin and Stringers - Stations 524-485 -  $\pm 45^\circ$  from Y-Axis Adjacent to ET. Weight of Component <30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.030  $g^2/Hz$   
 20 - 155 Hz @ +3 dB/oct  
 155 - 320 Hz @ 0.22  $g^2/Hz$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @ 0.17  $g^2/Hz$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0019  $g^2/Hz$

Composite = 11.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0077  $g^2/Hz$   
 20 - 115 Hz @ +3 dB/oct  
 115 - 170 Hz @ 0.045  $g^2/Hz$   
 170 - 400 Hz @ -9 dB/oct  
 400 - 700 Hz @ 0.0035  $g^2/Hz$   
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0012  $g^2/Hz$

Composite = 3.4  $g_{rms}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
 20 - 155 Hz @ +3 dB/oct  
 155 - 320 Hz @ 0.90  $g^2/Hz$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @ 0.70  $g^2/Hz$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0041  $g^2/Hz$

Composite = 22.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 115 Hz @ +3 dB/oct  
 115 - 170 Hz @ 0.18  $g^2/Hz$   
 170 - 400 Hz @ -9 dB/oct  
 400 - 700 Hz @ 0.014  $g^2/Hz$   
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0051  $g^2/Hz$

Composite = 6.9  $g_{rms}$

Subzone 8-1-1-2-B Input to Components Mounted on the SRB Forward Skirt Skin and Stringers — Stations 524-485 —  $\pm 45^\circ$  from Y-Axis and Adjacent to ET. Weight of Component  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 20 - 75 Hz @ +3 dB/oct  
 75 - 320 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @  $0.087 \text{ g}^2/\text{Hz}$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00050 \text{ g}^2/\text{Hz}$

Composite =  $8.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

No Change (see page 25)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 20 - 75 Hz @ +3 dB/oct  
 75 - 320 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0020 \text{ g}^2/\text{Hz}$

Composite =  $16.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 20 - 115 Hz @ +3 dB/oct  
 115 - 170 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 170 - 400 Hz @ -9 dB/oct  
 400 - 700 Hz @  $0.0070 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0024 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Subzone 8-1-1-2-C Input to Components Mounted on the SRB Forward Skirt Skin and Stringers — Stations 524-485 —  $\pm 45^\circ$  from Y-Axis Adjacent to ET. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 320 Hz @  $0.072 \text{ g}^2/\text{Hz}$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00032 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

No Change (see page 39)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 320 Hz @  $0.29 \text{ g}^2/\text{Hz}$   
 320 - 350 Hz @ -9 dB/oct  
 350 - 550 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
 550 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0013 \text{ g}^2/\text{Hz}$

Composite =  $13.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 20 - 115 Hz @ +3 dB/oct  
 115 - 170 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 170 - 400 Hz @ -9 dB/oct  
 400 - 700 Hz @  $0.0070 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0024 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$



Subzone 8-1-2      SRB Forward Skirt — Stations 524-485 —  $\pm 135^\circ$  from Y-Axis  
opposite the ET (General Specifications)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.012  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 750 Hz @ 0.062  $g^2/Hz$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0032  $g^2/Hz$

Composite = 8.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.015  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @ 0.075  $g^2/Hz$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @ 0.025  $g^2/Hz$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 6.6  $g_{rms}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 750 Hz @ 0.25  $g^2/Hz$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite = 16.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @ 0.30  $g^2/Hz$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @ 0.10  $g^2/Hz$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 13.3  $g_{rms}$

Subzone 8-1-2-1      SRB Forward Skirt Rings — Stations 524-485 —  $\pm 135^\circ$  from  
Y-Axis opposite the ET (General Specifications)

Same as Subzone 8-1-2-1-A below.

Subzone 8-1-2-1-A Input to Components Mounted on the SRB Forward Skirt Rings - Stations 524-485 -  $\pm 135^\circ$  from Y-Axis opposite the ET. Weight of Component  $< 40$  lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 29)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 30)

Subzone 8-1-2-1-B Input to Components Mounted on the SRB Forward Skirt Rings - Stations 524-485 -  $\pm 135^\circ$  from Y-Axis opposite the ET. Weight of Component  $\geq 40$  but  $< 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 31)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 31)

Subzone 8-1-2-1-C Input to Components Mounted on the SRB Forward Skirt Rings - Stations 524-485 -  $\pm 135^\circ$  from Y-Axis opposite the ET. Weight of Component  $\geq 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

No Change (see page 33)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

No Change (see page 33)

Subzone 8-1-2-2      SRB Forward Skirt Rings — Stations 524-485 —  $\pm 45^\circ$  from  
Y-Axis adjacent to ET (General Specifications)

Same as Subzone 8-1-2-2-A below.

Subzone 8-1-2-2-A      Input to Components Mounted on the SRB Forward Skirt Rings —  
Stations 524-485 —  $\pm 45^\circ$  from Y-Axis adjacent to ET. Weight  
of Component <40 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 750 Hz @  $0.062 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0032 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
180 - 510 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 750 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $16.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $13.3 \text{ g}_{\text{rms}}$

Subzone 8-1-2-2-B Input to Components Mounted on the SRB Forward Skirt Rings -  
Stations 524-485 -  $\pm 45^\circ$  from Y-Axis adjacent to ET. Weight  
of Component  $\geq 40$  but  $< 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
20 - 48 Hz @ +3 dB/oct  
48 - 750 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0016 \text{ g}^2/\text{Hz}$

Composite =  $5.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 180 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0025 \text{ g}^2/\text{Hz}$

Composite =  $4.8 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
20 - 48 Hz @ +3 dB/oct  
48 - 750 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0064 \text{ g}^2/\text{Hz}$

Composite =  $11.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 180 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $9.6 \text{ g}_{\text{rms}}$

Subzone 8-1-2-2-C Input to Components Mounted on the SRB Forward Skirt Kings -  
Stations 524-485 -  $\pm 45^\circ$  from Y-Axis adjacent to ET. Weight  
of Component  $\geq 80$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 - 750 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0011 \text{ g}^2/\text{Hz}$

Composite =  $4.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 - 180 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.0080 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0016 \text{ g}^2/\text{Hz}$

Composite =  $3.8 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 - 750 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0043 \text{ g}^2/\text{Hz}$

Composite =  $9.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 - 180 Hz @  $0.096 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$

Composite =  $7.7 \text{ g}_{\text{rms}}$

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.020  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 115 Hz @ 0.080  $g^2/Hz$   
115 - 300 Hz @ +3 dB/oct  
300 - 500 Hz @ 0.21  $g^2/Hz$   
500 - 840 Hz @ -9 dB/oct  
840 - 2000 Hz @ 0.045  $g^2/Hz$

Composite = 12.7  $g_{rms}$ 

## Long. and Tang. Axes

20 Hz @ 0.017  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 185 Hz @ 0.042  $g^2/Hz$   
185 - 570 Hz @ +3 dB/oct  
570 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 15.0  $g_{rms}$ 

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Radial Axis

20 Hz @ 0.036  $g^2/Hz$   
20 - 200 Hz @ +3 dB/oct  
200 - 555 Hz @ 0.36  $g^2/Hz$   
555 - 900 Hz @ -12 dB/oct  
900 - 1500 Hz @ 0.050  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 16.3  $g_{rms}$ 

## Long. and Tang. Axes

20 Hz @ 0.056  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 340 Hz @ 0.14  $g^2/Hz$   
340 - 400 Hz @ +6 dB/oct  
400 - 1200 Hz @ 0.19  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.11  $g^2/Hz$

Composite = 17.9  $g_{rms}$

## 8-2 (Cont.)

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 115 Hz @ 0.32  $g^2/Hz$   
 115 - 300 Hz @ +3 dB/oct  
 300 - 500 Hz @ 0.85  $g^2/Hz$   
 500 - 840 Hz @ -9 dB/oct  
 840 - 2000 Hz @ 0.18  $g^2/Hz$

Composite = 25.4  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.068  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 185 Hz @ 0.17  $g^2/Hz$   
 185 - 570 Hz @ +3 dB/oct  
 570 - 2000 Hz @ 0.52  $g^2/Hz$

Composite = 30.1  $g_{rms}$

### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.51  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 275 Hz @ 1.30  $g^2/Hz$   
 275 - 380 Hz @ -9 dB/oct  
 380 - 500 Hz @ 0.50  $g^2/Hz$   
 500 - 950 Hz @ -12 dB/oct  
 950 - 1500 Hz @ 0.040  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.023  $g^2/Hz$

Composite = 24.0  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 150 Hz @ 0.30  $g^2/Hz$   
 150 - 235 Hz @ -12 dB/oct  
 235 - 800 Hz @ 0.050  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0080  $g^2/Hz$

Composite = 9.6  $g_{rms}$

### 5. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

#### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-1      SRB Forward Skirt Skin and Stringers — Stations 484-434  
(General Specifications)

Same as Subzone 8-2-1-A below.

Subzone 8-2-1-A      Input to Components Mounted on the SRB Forward Skirt Skin or  
Stringers — Stations 484-434. Weight of Component <30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.012  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 105 Hz @ 0.050  $g^2/Hz$   
105 - 315 Hz @ +3 dB/oct  
315 - 600 Hz @ 0.15  $g^2/Hz$   
600 - 2000 Hz @ -5 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.00092  $g^2/Hz$   
20 - 85 Hz @ +6 dB/oct  
85 - 150 Hz @ 0.016  $g^2/Hz$   
150 - 325 Hz @ -6 dB/oct  
325 - 1500 Hz @ 0.0035  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0025  $g^2/Hz$

Composite = 2.9  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 200 Hz @ +6 dB/oct  
200 - 600 Hz @ 0.25  $g^2/Hz$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0020  $g^2/Hz$

Composite = 12.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0033  $g^2/Hz$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @ 0.083  $g^2/Hz$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @ 0.0090  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0045  $g^2/Hz$

Composite = 5.0  $g_{rms}$



# 8-2-1-A (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 105 Hz @ 0.20  $g^2/Hz$   
 105 - 315 Hz @ +3 dB/oct  
 315 - 600 Hz @ 0.60  $g^2/Hz$   
 600 - 2000 Hz @ -5 dB/oct  
 2000 Hz @ 0.081  $g^2/Hz$

Composite = 23.8  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.0037  $g^2/Hz$   
 20 - 85 Hz @ +6 dB/oct  
 85 - 150 Hz @ 0.066  $g^2/Hz$   
 150 - 325 Hz @ -6 dB/oct  
 325 - 1500 Hz @ 0.014  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 5.8  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 500 Hz @ 0.50  $g^2/Hz$   
 500 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0020  $g^2/Hz$

Composite = 17.5  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.025  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 150 Hz @ 0.10  $g^2/Hz$   
 150 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00057  $g^2/Hz$

Composite = 5.0  $g_{rms}$

## 5. Vehicle Dynamic Criteria

### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

## 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-1-B Input to Components Mounted on the SRB Forward Skirt Skin or Stringers - Stations 484-434. Weight of Component  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 56 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 56 - 170 Hz @ +3 dB/oct  
 170 - 600 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -5 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $8.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0062 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 150 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 150 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.00014 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
 20 - 140 Hz @ +6 dB/oct  
 140 - 600 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $9.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
 150 - 310 Hz @ -9 dB/oct  
 310 - 1000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 56 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 56 - 170 Hz @ +3 dB/oct  
 170 - 600 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -5 dB/oct  
 2000 Hz @  $0.041 \text{ g}^2/\text{Hz}$

Composite =  $17.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0027 \text{ g}^2/\text{Hz}$   
 20 - 85 Hz @ +6 dB/oct  
 85 - 150 Hz @  $0.049 \text{ g}^2/\text{Hz}$   
 150 - 325 Hz @ -6 dB/oct  
 325 - 1500 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0074 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

8-2-1-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 500 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $12.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 150 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
150 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.00057 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
20 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-1-C Input to Components Mounted on the SRB Forward Skirt Skin or Stringers — Stations 484-434. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 38 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 38 - 115 Hz @ +3 dB/oct  
 115 - 600 Hz @  $0.047 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -5 dB/oct  
 2000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$

Composite =  $7.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0062 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 150 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 150 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.00014 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
 20 - 115 Hz @ +6 dB/oct  
 115 - 600 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00065 \text{ g}^2/\text{Hz}$

Composite =  $7.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
 150 - 310 Hz @ -9 dB/oct  
 310 - 1000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 38 Hz @  $0.064 \text{ g}^2/\text{Hz}$   
 38 - 115 Hz @ +3 dB/oct  
 115 - 600 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -5 dB/oct  
 2000 Hz @  $0.026 \text{ g}^2/\text{Hz}$

Composite =  $14.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0027 \text{ g}^2/\text{Hz}$   
 20 - 85 Hz @ +6 dB/oct  
 85 - 150 Hz @  $0.049 \text{ g}^2/\text{Hz}$   
 150 - 325 Hz @ -6 dB/oct  
 325 - 1500 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0074 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

8-2-1-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 32 Hz @ +3 dB/oct  
32 - 500 Hz @ 0.16  $g^2/Hz$   
500 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00063  $g^2/Hz$

Composite = 10.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.025  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00057  $g^2/Hz$

Composite = 5.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-2      SRB Forward Skirt Rings — Stations 484-434 (General Specifications)

Same as Subzone 8-2-2-A below.

Subzone 8-2-2-A      Input to Components Mounted on the SRB Forward Skirt Rings — Stations 484-434.      Weight of Component <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.020  $G^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 115 Hz @ 0.080  $g^2/\text{Hz}$   
115 - 300 Hz @ +3 dB/oct  
300 - 500 Hz @ 0.21  $g^2/\text{Hz}$   
500 - 840 Hz @ -9 dB/oct  
840 - 2000 Hz @ 0.045  $g^2/\text{Hz}$

Composite = 12.7  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.017  $g^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 185 Hz @ 0.042  $g^2/\text{Hz}$   
185 - 570 Hz @ +3 dB/oct  
570 - 2000 Hz @ 0.10  $g^2/\text{Hz}$

Composite = 15.0  $g_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.036  $g^2/\text{Hz}$   
20 - 200 Hz @ +3 dB/oct  
200 - 400 Hz @ 0.36  $g^2/\text{Hz}$   
400 - 775 Hz @ -9 dB/oct  
775 - 1500 Hz @ 0.050  $g^2/\text{Hz}$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038  $g^2/\text{Hz}$

Composite = 14.8  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.056  $g^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 340 Hz @ 0.14  $g^2/\text{Hz}$   
340 - 400 Hz @ +6 dB/oct  
400 - 1200 Hz @ 0.19  $g^2/\text{Hz}$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.11  $g^2/\text{Hz}$

Composite = 17.9  $g_{\text{rms}}$

8-2-2-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 115 Hz @ 0.32  $g^2/Hz$   
 115 - 300 Hz @ +3 dB/oct  
 300 - 500 Hz @ 0.85  $g^2/Hz$   
 500 - 840 Hz @ -9 dB/oct  
 840 - 2000 Hz @ 0.18  $g^2/Hz$

Composite = 25.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.068  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 185 Hz @ 0.17  $g^2/Hz$   
 185 - 570 Hz @ +3 dB/oct  
 570 - 2000 Hz @ 0.52  $g^2/Hz$

Composite = 30.1  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.51  $g^2/Hz$   
 20 - 50 Hz @ +3 dB/oct  
 50 - 270 Hz @ 1.30  $g^2/Hz$   
 270 - 865 Hz @ -9 dB/oct  
 865 - 1500 Hz @ 0.040  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.023  $g^2/Hz$

Composite = 22.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.80  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 60 Hz @ 1.60  $g^2/Hz$   
 60 - 90 Hz @ -12 dB/oct  
 90 - 600 Hz @ 0.30  $g^2/Hz$   
 600 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.090  $g^2/Hz$

Composite = 21.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-2-B Input to Components Mounted on the SRB Forward Skirt Rings - Stations 484-434. Weight of Component  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 20 - 52 Hz @ +3 dB/oct  
 52 - 75 Hz @  $0.052 \text{ g}^2/\text{Hz}$   
 75 - 200 Hz @ +3 dB/oct  
 200 - 500 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
 500 - 840 Hz @ -9 dB/oct  
 840 - 2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 120 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
 120 - 370 Hz @ +3 dB/oct  
 370 - 2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $12.4 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.036 \text{ g}^2/\text{Hz}$   
 20 - 135 Hz @ +3 dB/oct  
 135 - 400 Hz @  $0.24 \text{ g}^2/\text{Hz}$   
 400 - 775 Hz @ -9 dB/oct  
 775 - 1500 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $12.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.056 \text{ g}^2/\text{Hz}$   
 20 - 34 Hz @ +3 dB/oct  
 34 - 280 Hz @  $0.093 \text{ g}^2/\text{Hz}$   
 280 - 330 Hz @ +6 dB/oct  
 330 - 1200 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 1200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.077 \text{ g}^2/\text{Hz}$

Composite =  $14.9 \text{ g}_{\text{rms}}$



### 8-2-2-B (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 52 Hz @ +3 dB/oct  
 52 - 75 Hz @ 0.21  $g^2/Hz$   
 75 - 200 Hz @ +3 dB/oct  
 200 - 500 Hz @ 0.56  $g^2/Hz$   
 500 - 840 Hz @ -9 dB/oct  
 840 - 2000 Hz @ 0.12  $g^2/Hz$

Composite = 21.3  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.068  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 120 Hz @ 0.11  $g^2/Hz$   
 120 - 370 Hz @ +3 dB/oct  
 270 - 2000 Hz @ 0.34  $g^2/Hz$

Composite = 24.9  $g_{rms}$

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.51  $g^2/Hz$   
 20 - 34 Hz @ +3 dB/oct  
 34 - 270 Hz @ 0.86  $g^2/Hz$   
 270 - 820 Hz @ -9 dB/oct  
 820 - 1500 Hz @ 0.031  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.017  $g^2/Hz$

Composite = 18.7  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.80  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 57 Hz @ 1.30  $g^2/Hz$   
 57 - 90 Hz @ -12 dB/oct  
 90 - 600 Hz @ 0.20  $g^2/Hz$   
 600 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.060  $g^2/Hz$

Composite = 17.6  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-2-2-C Input to Components Mounted on the SRB Forward Skirt Rings - Stations 484-434. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 - 46 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
46 - 125 Hz @ +3 dB/oct  
125 - 500 Hz @  $0.087 \text{ g}^2/\text{Hz}$   
500 - 840 Hz @ -9 dB/oct  
840 - 2000 Hz @  $0.018 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 75 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
75 - 230 Hz @ +3 dB/oct  
230 - 2000 Hz @  $0.052 \text{ g}^2/\text{Hz}$

Composite =  $9.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.036 \text{ g}^2/\text{Hz}$   
20 - 85 Hz @ +3 dB/oct  
85 - 400 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
400 - 775 Hz @ -9 dB/oct  
775 - 1500 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.016 \text{ g}^2/\text{Hz}$

Composite =  $10.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 220 Hz @  $0.058 \text{ g}^2/\text{Hz}$   
220 - 270 Hz @ +6 dB/oct  
270 - 1200 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.053 \text{ g}^2/\text{Hz}$

Composite =  $12.3 \text{ g}_{\text{rms}}$

8-2-2-C (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 46 Hz @ 0.13  $g^2/Hz$   
 46 - 125 Hz @ +3 dB/oct  
 125 - 500 Hz @ 0.35  $g^2/Hz$   
 500 - 840 Hz @ -9 dB/oct  
 840 - 2000 Hz @ 0.074  $g^2/Hz$

Composite = 17.2  $g_{rms}$

Long. and Tang. Axes

20 - 75 Hz @ 0.070  $g^2/Hz$   
 75 - 225 Hz @ +3 dB/oct  
 225 - 2000 Hz @ 0.21  $g^2/Hz$

Composite = 19.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.37  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 270 Hz @ 0.55  $g^2/Hz$   
 270 - 805 Hz @ -9 dB/oct  
 805 - 1500 Hz @ 0.021  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.012  $g^2/Hz$

Composite = 15.0  $g_{rms}$

Long. and Tang. Axes

20 - 55 Hz @ 0.80  $g^2/Hz$   
 55 - 90 Hz @ -12 dB/oct  
 90 - 600 Hz @ 0.10  $g^2/Hz$   
 600 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.030  $g^2/Hz$

Composite = 12.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3      SRB Forward Skirt — Stations 433-395 (General Specifications)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.035  $g^2/Hz$   
 20 - 73 Hz @ +3 dB/oct  
       73 Hz @ 0.12  $g^2/Hz$   
 73 - 250 Hz @ +6 dB/oct  
 250 - 600 Hz @ 1.00  $g^2/Hz$   
 600 - 620 Hz @ -12 dB/oct  
 620 - 700 Hz @ 0.85  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
       2000 Hz @ 0.038  $g^2/Hz$

Composite = 28.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
 20 - 120 Hz @ +3 dB/oct  
 120 - 1000 Hz @ 0.30  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
       2000 Hz @ 0.038  $g^2/Hz$

Composite = 19.8  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 115 Hz @ +3 dB/oct  
       115 Hz @ 0.082  $g^2/Hz$   
 115 - 200 Hz @ +6 dB/oct  
 200 - 715 Hz @ 0.25  $g^2/Hz$   
 715 - 2000 Hz @ -9 dB/oct  
       2000 Hz @ 0.012  $g^2/Hz$

Composite = 15.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.024  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 150 Hz @ 0.12  $g^2/Hz$   
 150 - 185 Hz @ -6 dB/oct  
 185 - 1000 Hz @ 0.080  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
       2000 Hz @ 0.020  $g^2/Hz$

Composite = 11.0  $g_{rms}$

### 8-3 (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.037  $g^2/Hz$   
 20 - 110 Hz @ +3 dB/oct  
 110 Hz @ 0.20  $g^2/Hz$   
 110 - 250 Hz @ +6 dB/oct  
 250 - 1050 Hz @ 1.00  $g^2/Hz$   
 1050 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 35.6  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.070  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 370 Hz @ 0.28  $g^2/Hz$   
 370 - 800 Hz @ +3 dB/oct  
 800 - 1250 Hz @ 0.60  $g^2/Hz$   
 1250 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 27.9  $g_{rms}$

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.14  $g^2/Hz$   
 20 - 73 Hz @ +3 dB/oct  
 73 Hz @ 0.50  $g^2/Hz$   
 73 - 250 Hz @ +6 dB/oct  
 250 - 600 Hz @ 4.00  $g^2/Hz$   
 600 - 620 Hz @ -12 dB/oct  
 620 - 700 Hz @ 3.40  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 56.3  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.20  $g^2/Hz$   
 20 - 120 Hz @ +3 dB/oct  
 120 - 1000 Hz @ 1.20  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 39.7  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-1      SRB Forward Skirt Skin and Stringers — Stations 433-395  
(General Specifications)

Same as Subzone 8-3-1-A below.

Subzone 8-3-1-A      Input to Components Mounted on the SRB Forward Skirt Skin  
or Stringers — Stations 433-395. Weight of Component <30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0065  $g^2/Hz$   
20 - 250 Hz @ +6 dB/oct  
250 - 600 Hz @ 1.00  $g^2/Hz$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0082  $g^2/Hz$

Composite = 25.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.020  $g^2/Hz$   
150 - 225 Hz @ -9 dB/oct  
225 - 1000 Hz @ 0.0058  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0014  $g^2/Hz$

Composite = 3.2  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 200 Hz @ +6 dB/oct  
200 - 600 Hz @ 0.25  $g^2/Hz$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0020  $g^2/Hz$

Composite = 12.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0033  $g^2/Hz$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @ 0.083  $g^2/Hz$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @ 0.0090  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0045  $g^2/Hz$

Composite = 5.0  $g_{rms}$

### 8-3-1-A (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.0066  $g^2/Hz$   
 20 - 250 Hz @ +6 dB/oct  
 250 - 800 Hz @ 1.00  $g^2/Hz$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.026  $g^2/Hz$

Composite = 29.7  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.0094  $g^2/Hz$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 150 Hz @ 0.080  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.023  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0058  $g^2/Hz$

Composite = 6.3  $g_{rms}$

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.026  $g^2/Hz$   
 20 - 250 Hz @ +6 dB/oct  
 250 - 600 Hz @ 4.00  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.033  $g^2/Hz$

Composite = 50.2  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 150 Hz @ 0.080  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.023  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0058  $g^2/Hz$

Composite = 6.4  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.0 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-1-B Input to Components Mounted on the SRB Forward Skirt Skin or Stringers — Stations 433-395. Weight of Component  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
20 - 175 Hz @ +6 dB/oct  
175 - 600 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0040 \text{ g}^2/\text{Hz}$

Composite =  $18.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00082 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @  $0.0022 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.0011 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +6 dB/oct  
140 - 600 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $9.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @  $0.0030 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$



8-3-1-B (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0066  $g^2/Hz$   
 20 - 175 Hz @ +3 dB/oct  
 175 - 800 Hz @ 0.50  $g^2/Hz$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.013  $g^2/Hz$

Composite = 21.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0059  $g^2/Hz$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 150 Hz @ 0.050  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.014  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0035  $g^2/Hz$

Composite = 5.0  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.026  $g^2/Hz$   
 20 - 175 Hz @ +6 dB/oct  
 175 - 600 Hz @ 2.00  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.016  $g^2/Hz$

Composite = 36.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 58 Hz @ +3 dB/oct  
 58 - 150 Hz @ 0.046  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.014  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0035  $g^2/Hz$

Composite = 5.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-1-C Input to Components Mounted on the SRB Forward Skirt Skin  
or Stringers - Stations 433-395. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +6 dB/oct  
140 - 600 Hz @  $0.32 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0028 \text{ g}^2/\text{Hz}$

Composite =  $15.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00083 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @  $0.0022 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.0011 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 115 Hz @ +6 dB/oct  
115 - 600 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00065 \text{ g}^2/\text{Hz}$

Composite =  $7.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 H. @  $0.0033 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 150 Hz @  $0.083 \text{ g}^2/\text{Hz}$   
150 - 310 Hz @ -9 dB/oct  
310 - 1000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### 8-3-1-C (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.0006  $g^2/Hz$   
 20 - 140 Hz @ +6 dB/oct  
 140 - 800 Hz @ 0.32  $g^2/Hz$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0083  $g^2/Hz$

Composite = 17.5  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.0059  $g^2/Hz$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 150 Hz @ 0.050  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.014  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0035  $g^2/Hz$

Composite = 5.0  $g_{rms}$

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.026  $g^2/Hz$   
 20 - 140 Hz @ +6 dB/oct  
 140 - 600 Hz @ 1.30  $g^2/Hz$   
 600 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.011  $g^2/Hz$

Composite = 30.2  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 58 Hz @ +3 dB/oct  
 58 - 150 Hz @ 0.046  $g^2/Hz$   
 150 - 225 Hz @ -9 dB/oct  
 225 - 1000 Hz @ 0.014  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 @ 0.0035  $g^2/Hz$

Composite = 5.0  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-2      SRB Forward Skirt Ring at Station 424 (General Specifications)

Same as Subzone 8-3-2-A below.

Subzone 8-3-2-A      Input to Components Mounted on the SRB Forward Skirt Ring at Station 424. Weight of Component <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.035  $g^2/Hz$   
20 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.85  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 25.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 120 Hz @ +3 dB/oct  
120 - 1000 Hz @ 0.30  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 19.8  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 315 Hz @ 0.11  $g^2/Hz$   
315 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.18  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 13.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.024  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.12  $g^2/Hz$   
150 - 185 Hz @ -6 dB/oct  
185 - 1000 Hz @ 0.080  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 11.0  $g_{rms}$

8-3-2-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 6.037  $g^2/Hz$   
 20 - 540 Hz @ +3 dB/oct  
 540 - 1050 Hz @ 1.00  $g^2/Hz$   
 1050 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 34.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 6.070  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 370 Hz @ 0.28  $g^2/Hz$   
 370 - 800 Hz @ +3 dB/oct  
 800 - 1250 Hz @ 0.60  $g^2/Hz$   
 1250 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 27.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.14  $g^2/Hz$   
 20 - 500 Hz @ +3 dB/oct  
 500 - 700 Hz @ 3.40  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 50.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.20  $g^2/Hz$   
 20 - 120 Hz @ +3 dB/oct  
 120 - 1000 Hz @ 1.20  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 39.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-C-2-B Input to Components Mounted on the SRB Forward Skirt Ring at Station 424. Weight of Component  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
 20 - 340 Hz @ +3 dB/oct  
 340 - 700 Hz @  $0.58 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $21.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 1000 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $16.3 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 260 Hz @  $0.073 \text{ g}^2/\text{Hz}$   
 260 - 330 Hz @ +6 dB/oct  
 330 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0077 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
 20 - 63 Hz @ +3 dB/oct  
 63 - 150 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 150 - 185 Hz @ -6 dB/oct  
 185 - 1000 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $8.8 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 350 Hz @ +3 dB/oct  
 350 - 1050 Hz @  $0.66 \text{ g}^2/\text{Hz}$   
 1050 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.096 \text{ g}^2/\text{Hz}$

Composite =  $28.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.069 \text{ g}^2/\text{Hz}$   
 20 - 52 Hz @ +3 dB/oct  
 52 - 370 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 370 - 825 Hz @ +3 dB/oct  
 825 - 1250 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 1250 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.098 \text{ g}^2/\text{Hz}$

Composite =  $22.7 \text{ g}_{\text{rms}}$

8-3-2-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
20 - 340 Hz @ +3 dB/oct  
340 - 700 Hz @  $2.30 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $43.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 1000 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $32.7 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-2-C Input to Components Mounted on the SRB Forward Skirt Ring at Station 424. Weight of Component 260 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.035  $g^2/Hz$   
 20 - 210 Hz @ +3 dB/oct  
 210 - 700 Hz @ 0.35  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.016  $g^2/Hz$

Composite = 17.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.032  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 1000 Hz @ 0.12  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.016  $g^2/Hz$

Composite = 12.9  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 65 Hz @ +3 dB/oct  
 65 - 200 Hz @ 0.047  $g^2/Hz$   
 200 - 260 Hz @ +6 dB/oct  
 260 - 800 Hz @ 0.077  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0050  $g^2/Hz$

Composite = 8.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.024  $g^2/Hz$   
 20 - 42 Hz @ +3 dB/oct  
 42 - 150 Hz @ 0.050  $g^2/Hz$   
 150 - 185 Hz @ -6 dB/oct  
 185 - 1000 Hz @ 0.033  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0083  $g^2/Hz$

Composite = 7.1  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.038  $g^2/Hz$   
 20 - 225 Hz @ +3 dB/oct  
 225 - 1050 Hz @ 0.42  $g^2/Hz$   
 1050 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.061  $g^2/Hz$

Composite = 23.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.069  $g^2/Hz$   
 20 - 35 Hz @ +3 dB/oct  
 35 - 370 Hz @ 0.12  $g^2/Hz$   
 370 - 770 Hz @ +3 dB/oct  
 770 - 1250 Hz @ 0.25  $g^2/Hz$   
 1250 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.061  $g^2/Hz$

Composite = 18.2  $g_{rms}$



8-3-2-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
20 - 210 Hz @ +3 dB/oct  
210 - 700 Hz @  $1.40 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.061 \text{ g}^2/\text{Hz}$

Composite =  $35.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 1000 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.063 \text{ g}^2/\text{Hz}$

Composite =  $25.8 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-3      SRB Forward Skirt Ring at Station 401 (General Specifications)

Same as Subzone 8-3-3-A below.

Subzone 8-3-3-A      Input to Components Mounted on the SRB Forward Skirt Ring at Station 401. Weight of Component <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.32  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.014  $g^2/Hz$

Composite = 15.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 1000 Hz @ 0.12  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 12.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0054  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 320 Hz @ 0.040  $g^2/Hz$   
320 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.065  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0042  $g^2/Hz$

Composite = 7.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.050  $g^2/Hz$   
150 - 190 Hz @ -6 dB/oct  
190 - 1000 Hz @ 0.030  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0075  $g^2/Hz$

Composite = 6.8  $g_{rms}$

8-3-3-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 600 Hz @ +3 dB/oct  
 600 - 1000 Hz @ 0.44  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.055  $g^2/Hz$

Composite = 21.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.028  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 360 Hz @ 0.11  $g^2/Hz$   
 360 - 720 Hz @ +3 dB/oct  
 720 - 1300 Hz @ 0.22  $g^2/Hz$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.060  $g^2/Hz$

Composite = 17.5  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
 20 - 500 Hz @ +3 dB/oct  
 500 - 700 Hz @ 1.30  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.056  $g^2/Hz$

Composite = 31.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.064  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 1000 Hz @ 0.48  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.060  $g^2/Hz$

Composite = 25.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-3-B Input to Components Mounted on the SRB Forward Skirt Ring at Station 401. Weight of Component  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
 20 - 350 Hz @ +3 dB/oct  
 350 - 700 Hz @ 0.22  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0098  $g^2/Hz$

Composite = 13.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 1000 Hz @ 0.080  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 10.3  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0054  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 250 Hz @ 0.026  $g^2/Hz$   
 250 - 320 Hz @ +6 dB/oct  
 320 - 800 Hz @ 0.043  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0028  $g^2/Hz$

Composite = 6.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
 20 - 65 Hz @ +3 dB/oct  
 65 - 150 Hz @ 0.033  $g^2/Hz$   
 150 - 190 Hz @ -6 dB/oct  
 190 - 1000 Hz @ 0.020  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0050  $g^2/Hz$

Composite = 5.6  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 380 Hz @ +3 dB/oct  
 380 - 1000 Hz @ 0.28  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.035  $g^2/Hz$

Composite = 18.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.027  $g^2/Hz$   
 20 - 54 Hz @ +3 dB/oct  
 54 - 360 Hz @ 0.074  $g^2/Hz$   
 360 - 680 Hz @ +3 dB/oct  
 680 - 1300 Hz @ 0.14  $g^2/Hz$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.039  $g^2/Hz$

Composite = 14.1  $g_{rms}$

8-3-3-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
20 - 350 Hz @ +3 dB/oct  
350 - 700 Hz @ 0.90  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.039  $g^2/Hz$

Composite = 27.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.064  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.32  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.040  $g^2/Hz$

Composite = 20.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-3-3-C Input to Components Mounted on the SRB Forward Skirt Ring at Station 401. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0088 \text{ g}^2/\text{Hz}$   
 20 - 320 Hz @ +3 dB/oct  
 320 - 700 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0060 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 1000 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0062 \text{ g}^2/\text{Hz}$

Composite =  $8.1 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec-mission in each axis)

Radial Axis

20 Hz @  $0.0054 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +3 dB/oct  
 60 - 200 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 200 - 260 Hz @ +6 dB/oct  
 260 - 800 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0018 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 20 - 52 Hz @ +3 dB/oct  
 52 - 150 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 150 - 190 Hz @ -6 dB/oct  
 190 - 1000 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0040 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 20 - 250 Hz @ +3 dB/oct  
 250 - 1000 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $15.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
 20 - 33 Hz @ +3 dB/oct  
 33 - 360 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
 360 - 720 Hz @ +3 dB/oct  
 720 - 1300 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $11.2 \text{ g}_{\text{rms}}$

8-3-3-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.035  $g^2/Hz$   
20 - 320 Hz @ +3 dB/oct  
320 - 700 Hz @ 0.56  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.024  $g^2/Hz$

Composite = 21.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.20  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 16.3  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-4 SRB Forward Skirt Bulkhead (General Specifications)

Same as Subzone 8-4-A below.

Subzone 8-4-A Input to Components Mounted on the SRB Forward Skirt Bulkhead. Weight of Component <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0075  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 63 Hz @ 0.015  $g^2/Hz$   
63 - 200 Hz @ +9 dB/oct  
200 - 500 Hz @ 0.45  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0072  $g^2/Hz$

Composite = 16.2  $g_{rms}$

Directions B and C

20 Hz @ 0.0019  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 63 Hz @ 0.0038  $g^2/Hz$   
63 - 200 Hz @ +9 dB/oct  
200 - 500 Hz @ 0.11  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0018  $g^2/Hz$

Composite = 8.1  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Direction A

20 Hz @ 0.00030  $g^2/Hz$   
20 - 200 Hz @ +9 dB/oct  
200 - 500 Hz @ 0.30  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0048  $g^2/Hz$

Composite = 13.3  $g_{rms}$

Directions B and C

20 Hz @ 0.000075  $g^2/Hz$   
20 - 200 Hz @ +9 dB/oct  
200 - 500 Hz @ 0.075  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0012  $g^2/Hz$

Composite = 6.7  $g_{rms}$



8-4-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Direction A

20 Hz @ 0.030  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 133 Hz @ 0.060  $g^2/Hz$   
 133 - 245 Hz @ +15 dB/oct  
 245 - 440 Hz @ 1.30  $g^2/Hz$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @ 0.040  $g^2/Hz$

Composite = 22.9  $g_{rms}$

Directions B and C

20 Hz @ 0.0075  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 133 Hz @ 0.015  $g^2/Hz$   
 133 - 245 Hz @ +15 dB/oct  
 245 - 440 Hz @ 0.32  $g^2/Hz$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @ 0.010  $g^2/Hz$

Composite = 11.4  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Direction A

20 Hz @ 0.030  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 63 Hz @ 0.060  $g^2/Hz$   
 63 - 200 Hz @ +9 dB/oct  
 200 - 500 Hz @ 1.80  $g^2/Hz$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.029  $g^2/Hz$

Composite = 32.5  $g_{rms}$

Directions B and C

20 Hz @ 0.0075  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 63 Hz @ 0.015  $g^2/Hz$   
 63 - 200 Hz @ +9 dB/oct  
 200 - 500 Hz @ 0.45  $g^2/Hz$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0072  $g^2/Hz$

Composite = 16.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
 5 - 10 Hz @ 0.7 G's peak  
 10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
 5 - 10 Hz @ 0.5 G's peak  
 10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

8-4-A (Cont.)

6. Shock Test Criteria (2 shocks/axis)

See Tables VII, IX and X.

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

## Subzone 8-4-B

Input to Components Mounted on the SRB Forward Skirt Bulkhead. Weight of Component  $\geq 20$  but  $< 60$  lb.

## 1. Acceptance Test Criteria (1 min/axis)

## Direction A

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 56 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 56 - 146 Hz @ +9 dB/oct  
 146 - 500 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0033 \text{ g}^2/\text{Hz}$

Composite =  $11.4 \text{ g}_{\text{rms}}$

## Directions B and C

20 Hz @  $0.0019 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 56 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
 56 - 146 Hz @ +9 dB/oct  
 146 - 500 Hz @  $0.053 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00083 \text{ g}^2/\text{Hz}$

Composite =  $5.7 \text{ g}_{\text{rms}}$

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Direction A

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 160 Hz @ +9 dB/oct  
 160 - 500 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0022 \text{ g}^2/\text{Hz}$

Composite =  $9.3 \text{ g}_{\text{rms}}$

## Directions B and C

20 Hz @  $0.000075 \text{ g}^2/\text{Hz}$   
 20 - 170 Hz @ +9 dB/oct  
 170 - 500 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00067 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

## Direction A

20 - 115 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 115 - 210 Hz @ +15 dB/oct  
 210 - 440 Hz @  $0.60 \text{ g}^2/\text{Hz}$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @  $0.018 \text{ g}^2/\text{Hz}$

Composite =  $16.1 \text{ g}_{\text{rms}}$

## Directions B and C

20 - 115 Hz @  $0.0070 \text{ g}^2/\text{Hz}$   
 115 - 215 Hz @ +15 dB/oct  
 215 - 440 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @  $0.0046 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

8-4-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Direction A

20 Hz @ 0.030  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 56 Hz @ 0.045  $g^2/Hz$   
56 - 146 Hz @ +9 dB/oct  
146 - 500 Hz @ 0.83  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite = 22.8  $g_{rms}$

Directions B and C

20 Hz @ 0.0075  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 56 Hz @ 0.011  $g^2/Hz$   
56 - 146 Hz @ +9 dB/oct  
146 - 500 Hz @ 0.21  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0033  $g^2/Hz$

Composite = 11.4  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VII, IX and X.

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 8-4-C

Input to Components Mounted on the SRB Forward Skirt Bulkhead. Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 - 46 Hz @  $0.0060 \text{ g}^2/\text{Hz}$   
 46 - 115 Hz @ +9 dB/oct  
 115 - 500 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0014 \text{ g}^2/\text{Hz}$

Composite =  $7.6 \text{ g}_{\text{rms}}$

Directions B and C

20 - 46 Hz @  $0.0015 \text{ g}^2/\text{Hz}$   
 46 - 115 Hz @ +9 dB/oct  
 115 - 500 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00035 \text{ g}^2/\text{Hz}$

Composite =  $3.8 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Direction A

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 120 Hz @ +9 dB/oct  
 120 - 500 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00095 \text{ g}^2/\text{Hz}$

Composite =  $6.2 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.000075 \text{ g}^2/\text{Hz}$   
 20 - 170 Hz @ +9 dB/oct  
 170 - 500 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00067 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Direction A

20 - 96 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 96 - 180 Hz @ +15 dB/oct  
 180 - 440 Hz @  $0.26 \text{ g}^2/\text{Hz}$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @  $0.0080 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

Directions B and C

20 - 96 Hz @  $0.0030 \text{ g}^2/\text{Hz}$   
 96 - 180 Hz @ +15 dB/oct  
 180 - 440 Hz @  $0.064 \text{ g}^2/\text{Hz}$   
 440 - 1050 Hz @ -12 dB/oct  
 1050 - 2000 Hz @  $0.0020 \text{ g}^2/\text{Hz}$

Composite =  $5.4 \text{ g}_{\text{rms}}$

8-4-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Direction A

20 - 46 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
46 - 115 Hz @ +9 dB/oct  
115 - 500 Hz @  $0.36 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0057 \text{ g}^2/\text{Hz}$

Composite =  $15.3 \text{ g}_{\text{rms}}$

Directions B and C

20 - 46 Hz @  $0.0060 \text{ g}^2/\text{Hz}$   
46 - 115 Hz @ +9 dB/oct  
115 - 500 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0014 \text{ g}^2/\text{Hz}$

Composite =  $7.7 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VII, IX and X.

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Portions of the following section (subzone 8-5) were updated as a result of the IS-2 Ames (3.5%) Model Wind Tunnel Tests. New pages 105 through 120 provide revised Boost Random Vibration Criteria, additional subzones, and revised Acceptance Test Criteria where dictated by changes in the Boost Random Criteria. These new pages should be used in conjunction with pages 88 through 104 for determining Design Test Criteria.

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.022  $g^2/Hz$   
 20 - 43 Hz @ +6 dB/oct  
 43 - 300 Hz @ 0.10  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1200 Hz @ 0.015  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0055  $g^2/Hz$

Composite = 7.6  $g_{rms}$ 

## Long. and Tang. Axes

20 Hz @ 0.0078  $g^2/Hz$   
 20 - 39 Hz @ +3 dB/oct  
 39 - 102 Hz @ 0.015  $g^2/Hz$   
 102 - 187 Hz @ +6 dB/oct  
 187 - 1500 Hz @ 0.050  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.028  $g^2/Hz$

Composite = 9.4  $g_{rms}$ 

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @ 0.20  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1500 Hz @ 0.030  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.017  $g^2/Hz$

Composite = 11.1  $g_{rms}$ 

## Long. and Tang. Axes

20 Hz @ 0.045  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 1000 Hz @ 0.090  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.022  $g^2/Hz$

Composite = 11.5  $g_{rms}$ 

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

## Radial Axis

20 Hz @ 0.088  $g^2/Hz$   
 20 - 43 Hz @ +6 dB/oct  
 43 - 300 Hz @ 0.40  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1200 Hz @ 0.060  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.022  $g^2/Hz$

Composite = 15.3  $g_{rms}$ 

## Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 39 Hz @ +3 dB/oct  
 39 - 102 Hz @ 0.060  $g^2/Hz$   
 102 - 187 Hz @ +6 dB/oct  
 187 - 1500 Hz @ 0.20  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.11  $g^2/Hz$

Composite = 18.9  $g_{rms}$



8-5 (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.35  $g^2/Hz$   
20 - 38 Hz @ +6 dB/oct  
38 - 60 Hz @ 1.30  $g^2/Hz$   
60 - 80 Hz @ -12 dB/oct  
80 - 230 Hz @ 0.46  $g^2/Hz$   
230 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0065  $g^2/Hz$

Composite = 14.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.60  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 50 Hz @ 0.90  $g^2/Hz$   
50 - 80 Hz @ -12 dB/oct  
80 - 500 Hz @ 0.15  $g^2/Hz$   
500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.036  $g^2/Hz$

Composite = 14.3  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, VI, IX and X.

\* Design Criteria Only

Subzone 8-5-A      Input to SRB Forward Skirt Avionics Panels.    Total Weight of Panel and Components <80 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.014  $g^2/Hz$   
 20 - 140 Hz @ +3 dB/oct  
 140 - 300 Hz @ 0.10  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1200 Hz @ 0.015  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0055  $g^2/Hz$

Composite = 7.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0075  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 135 Hz @ 0.015  $g^2/Hz$   
 135 - 250 Hz @ +6 dB/oct  
 250 - 400 Hz @ 0.050  $g^2/Hz$   
 400 - 520 Hz @ -15 dB/oct  
 520 - 700 Hz @ 0.015  $g^2/Hz$   
 700 - 900 Hz @ +15 dB/oct  
 900 - 1500 Hz @ 0.050  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.028  $g^2/Hz$

Composite = 8.6  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.036  $g^2/Hz$   
 20 - 110 Hz @ +3 dB/oct  
 110 - 300 Hz @ 0.20  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1500 Hz @ 0.030  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.017  $g^2/Hz$

Composite = 10.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.045  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 400 Hz @ 0.090  $g^2/Hz$   
 400 - 500 Hz @ -15 dB/oct  
 500 - 600 Hz @ 0.030  $g^2/Hz$   
 600 - 750 Hz @ +15 dB/oct  
 750 - 1000 Hz @ 0.090  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.022  $g^2/Hz$

Composite = 10.9  $g_{rms}$

8-5-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.057  $g^2/Hz$   
 20 - 140 Hz @ +3 dB/oct  
 140 - 300 Hz @ 0.40  $g^2/Hz$   
 300 - 775 Hz @ -6 dB/oct  
 775 - 1200 Hz @ 0.060  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.022  $g^2/Hz$

Composite = 14.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.030  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 135 Hz @ 0.060  $g^2/Hz$   
 135 - 250 Hz @ +6 dB/oct  
 250 - 400 Hz @ 0.20  $g^2/Hz$   
 400 - 520 Hz @ -15 dB/oct  
 520 - 700 Hz @ 0.060  $g^2/Hz$   
 700 - 900 Hz @ +15 dB/oct  
 900 - 1500 Hz @ 0.20  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.11  $g^2/Hz$

Composite = 17.2  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.35  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 60 Hz @ 0.70  $g^2/Hz$   
 60 - 68 Hz @ -9 dB/oct  
 68 - 230 Hz @ 0.46  $g^2/Hz$   
 230 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0065  $g^2/Hz$

Composite = 14.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.60  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 50 Hz @ 0.90  $g^2/Hz$   
 50 - 80 Hz @ -12 dB/oct  
 80 - 360 Hz @ 0.15  $g^2/Hz$   
 360 - 480 Hz @ -15 dB/oct  
 480 - 600 Hz @ 0.040  $g^2/Hz$   
 600 - 750 Hz @ +9 dB/oct  
 750 - 900 Hz @ 0.080  $g^2/Hz$   
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.036  $g^2/Hz$

Composite = 13.0  $g_{rms}$

8-5-A (Cont.)

5. Vehicle Dynamics Criteria

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-5-A-1 Input to Components Mounted on the SRB Forward Skirt  
Avionics Panels. Total Weight of Components On Panel <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.016  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 300 Hz @ 0.10  $g^2/Hz$   
300 - 775 Hz @ -6 dB/oct  
775 - 1200 Hz @ 0.015  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0055  $g^2/Hz$

Composite = 7.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0075  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 135 Hz @ 0.015  $g^2/Hz$   
135 - 250 Hz @ +6 dB/oct  
250 - 1500 Hz @ 0.050  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.028  $g^2/Hz$

Composite = 9.3  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.20  $g^2/Hz$   
300 - 775 Hz @ -6 dB/oct  
775 - 1500 Hz @ 0.030  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.017  $g^2/Hz$

Composite = 11.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.045  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @ 0.090  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.022  $g^2/Hz$

Composite = 11.5  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.065  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 300 Hz @ 0.40  $g^2/Hz$   
300 - 775 Hz @ -6 dB/oct  
775 - 1200 Hz @ 0.060  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.022  $g^2/Hz$

Composite = 15.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.030  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 135 Hz @ 0.060  $g^2/Hz$   
135 - 250 Hz @ +6 dB/oct  
250 - 1500 Hz @ 0.20  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.11  $g^2/Hz$

Composite = 18.6  $g_{rms}$

8-5-A-1 (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.35  $g^2/Hz$   
20 - 38 Hz @ +6 dB/oct  
38 - 60 Hz @ 1.30  $g^2/Hz$   
60 - 80 Hz @ -12 dB/oct  
80 - 230 Hz @ 0.46  $g^2/Hz$   
230 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0065  $g^2/Hz$

Composite = 14.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.60  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 50 Hz @ 0.90  $g^2/Hz$   
50 - 80 Hz @ -12 dB/oct  
80 - 500 Hz @ 0.15  $g^2/Hz$   
500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.036  $g^2/Hz$

Composite = 14.3  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Table VI, IX and X.

\* Design Criteria Only

Subzone 8-5-B

Input to SRB Forward Skirt Avionics Panels. Total Weight of Panel and Components  $\geq 80$  but  $< 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
 20 - 125 Hz @ +3 dB/oct  
 125 - 300 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 300 - 800 Hz @ -6 dB/oct  
 800 - 1200 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 120 - 200 Hz @ +6 dB/oct  
 200 - 350 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 350 - 450 Hz @ -15 dB/oct  
 450 - 550 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 550 - 700 Hz @ +15 dB/oct  
 700 - 1400 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.036 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 300 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 300 - 800 Hz @ -6 dB/oct  
 800 - 1300 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 1300 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $10.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 340 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 340 - 420 Hz @ -15 dB/oct  
 420 - 560 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 560 - 700 Hz @ +15 dB/oct  
 700 - 1000 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $10.2 \text{ g}_{\text{rms}}$

# 8-5-B (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

	20 Hz @ 0.057 $g^2/Hz$
20 -	125 Hz @ +3 dB/oct
125 -	300 Hz @ 0.35 $g^2/Hz$
300 -	800 Hz @ -6 dB/oct
800 -	1200 Hz @ 0.050 $g^2/Hz$
1200 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.018 $g^2/Hz$

Composite = 13.9  $g_{rms}$

### Long. and Tang. Axes

	20 Hz @ 0.030 $g^2/Hz$
20 -	40 Hz @ +3 dB/oct
40 -	120 Hz @ 0.060 $g^2/Hz$
120 -	200 Hz @ +6 dB/oct
200 -	350 Hz @ 0.17 $g^2/Hz$
350 -	450 Hz @ -15 dB/oct
450 -	550 Hz @ 0.050 $g^2/Hz$
550 -	700 Hz @ +15 dB/oct
700 -	1400 Hz @ 0.17 $g^2/Hz$
1400 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.082 $g^2/Hz$

Composite = 16.1  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

	20 Hz @ 0.35 $g^2/Hz$
20 -	34 Hz @ +3 dB/oct
34 -	50 Hz @ 0.60 $g^2/Hz$
50 -	58 Hz @ -9 dB/oct
58 -	230 Hz @ 0.40 $g^2/Hz$
230 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.0056 $g^2/Hz$

Composite = 13.0  $g_{rms}$

### Long. and Tang. Axes

	20 Hz @ 0.58 $g^2/Hz$
20 -	28 Hz @ +3 dB/oct
28 -	40 Hz @ 0.80 $g^2/Hz$
40 -	65 Hz @ -12 dB/oct
65 -	340 Hz @ 0.13 $g^2/Hz$
340 -	450 Hz @ -15 dB/oct
450 -	600 Hz @ 0.030 $g^2/Hz$
600 -	700 Hz @ +15 dB/oct
700 -	800 Hz @ 0.070 $g^2/Hz$
800 -	2000 Hz @ -3 dB/oct
	2000 Hz @ 0.028 $g^2/Hz$

Composite = 11.6  $g_{rms}$



8-5-B (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X.

\* Design Criteria Only

Subzone 8-5-B-1 Input to Components Mounted on the SRB Forward Skirt Avionics Panels. Total Weight of Components on Panel  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 300 - 800 Hz @ -6 dB/oct  
 800 - 1200 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0045 \text{ g}^2/\text{Hz}$

Composite =  $7.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 120 - 200 Hz @ +6 dB/oct  
 200 - 1400 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $8.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 20 - 38 Hz @ +6 dB/oct  
 38 - 300 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 300 - 800 Hz @ -6 dB/oct  
 800 - 1200 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 1300 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $10.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 1000 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
 300 - 800 Hz @ -6 dB/oct  
 800 - 1200 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.018 \text{ g}^2/\text{Hz}$

Composite =  $14.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 120 - 200 Hz @ +6 dB/oct  
 200 - 1400 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.082 \text{ g}^2/\text{Hz}$

Composite =  $17.0 \text{ g}_{\text{rms}}$

8-5-B-1 (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
20 - 36 Hz @ +6 dB/oct  
36 - 60 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
60 - 80 Hz @ -12 dB/oct  
80 - 230 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
230 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0056 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.58 \text{ g}^2/\text{Hz}$   
20 - 28 Hz @ +3 dB/oct  
28 - 40 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
40 - 65 Hz @ -12 dB/oct  
65 - 450 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
450 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.028 \text{ g}^2/\text{Hz}$

Composite =  $12.6 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VI, IX and X.

\* Design Criteria Only

Subzone 8-5-C

Input to SRB Forward Skirt Avionics Panels. Total Weight of Panel and Components  $\geq 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.014  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 250 Hz @ 0.070  $g^2/Hz$   
 250 - 670 Hz @ -6 dB/oct  
 670 - 1000 Hz @ 0.010  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0025  $g^2/Hz$

Composite = 5.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0078  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 94 Hz @ 0.012  $g^2/Hz$   
 94 - 150 Hz @ +6 dB/oct  
 150 - 300 Hz @ 0.032  $g^2/Hz$   
 300 - 380 Hz @ -15 dB/oct  
 380 - 510 Hz @ 0.010  $g^2/Hz$   
 510 - 650 Hz @ +15 dB/oct  
 650 - 1000 Hz @ 0.032  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.082  $g^2/Hz$

Composite = 6.3  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.030  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 250 Hz @ 0.15  $g^2/Hz$   
 250 - 675 Hz @ -6 dB/oct  
 675 - 1200 Hz @ 0.020  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0070  $g^2/Hz$

Composite = 8.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.034  $g^2/Hz$   
 20 - 36 Hz @ +3 dB/oct  
 36 - 300 Hz @ 0.060  $g^2/Hz$   
 300 - 370 Hz @ -15 dB/oct  
 370 - 520 Hz @ 0.020  $g^2/Hz$   
 520 - 650 Hz @ +15 dB/oct  
 650 - 1000 Hz @ 0.060  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.015  $g^2/Hz$

Composite = 8.8  $g_{rms}$

8-5-C (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.056  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 250 Hz @ 0.28  $g^2/Hz$   
 250 - 670 Hz @ -6 dB/oct  
 670 - 1000 Hz @ 0.040  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 11.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 94 Hz @ 0.050  $g^2/Hz$   
 94 - 150 Hz @ +6 dB/oct  
 150 - 300 Hz @ 0.13  $g^2/Hz$   
 300 - 380 Hz @ -15 dB/oct  
 280 - 510 Hz @ 0.040  $g^2/Hz$   
 510 - 650 Hz @ +15 dB/oct  
 650 - 1000 Hz @ 0.13  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.033  $g^2/Hz$

Composite = 12.7  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.34  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 50 Hz @ 0.50  $g^2/Hz$   
 50 - 58 Hz @ -9 dB/oct  
 58 - 200 Hz @ 0.32  $g^2/Hz$   
 200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0036  $g^2/Hz$

Composite = 10.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.60  $g^2/Hz$   
 40 - 60 Hz @ -12 dB/oct  
 60 - 300 Hz @ 0.10  $g^2/oct$   
 300 - 400 Hz @ -15 dB/oct  
 400 - 500 Hz @ 0.025  $g^2/Hz$   
 500 - 600 Hz @ +12 dB/oct  
 600 - 800 Hz @ 0.054  $g^2/Hz$   
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.021  $g^2/Hz$

Composite = 10.2  $g_{rms}$

8-5-C (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axis

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables V, IX and X

\*Design Criteria Only

Subzone 8-5-C-1 Input to Components Mounted on the SRB Forward Skirt Avionics Panels. Total Weight of Components On Panel = 60 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.085  $g^2/Hz$   
 20 - 34 Hz @ +6 dB/oct  
 34 - 60 Hz @ 0.25  $g^2/Hz$   
 60 - 80 Hz @ -12 dB/oct  
 80 - 200 Hz @ 0.08  $g^2/Hz$   
 200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00090  $g^2/Hz$

Composite = 5.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0078  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 94 Hz @ 0.012  $g^2/Hz$   
 94 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.032  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0082  $g^2/Hz$

Composite = 6.8  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
 20 - 34 Hz @ +6 dB/oct  
 34 - 250 Hz @ 0.15  $g^2/Hz$   
 250 - 675 Hz @ -6 dB/oct  
 675 - 1200 Hz @ 0.020  $g^2/Hz$   
 1200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0070  $g^2/Hz$

Composite = 8.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.034  $g^2/Hz$   
 20 - 36 Hz @ +3 dB/oct  
 36 - 1000 Hz @ 0.060  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.015  $g^2/Hz$

Composite = 9.4  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.086  $g^2/Hz$   
 20 - 36 Hz @ +6 dB/oct  
 36 - 250 Hz @ 0.28  $g^2/Hz$   
 250 - 670 Hz @ -6 dB/oct  
 670 - 1000 Hz @ 0.040  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 11.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.031  $g^2/Hz$   
 20 - 32 Hz @ +3 dB/oct  
 32 - 94 Hz @ 0.050  $g^2/Hz$   
 94 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.13  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.033  $g^2/Hz$

Composite = 13.6  $g_{rms}$

2-5-C-1 (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.34  $g^2/Hz$   
20 - 34 Hz @ +6 dB/oct  
34 - 60 Hz @ 1.00  $g^2/Hz$   
60 - 80 Hz @ -12 dB/oct  
80 - 200 Hz @ 0.32  $g^2/Hz$   
200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0036  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.60  $g^2/Hz$   
40 - 60 Hz @ -12 dB/oct  
60 - 420 Hz @ 0.10  $g^2/Hz$   
420 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.021  $g^2/Hz$

Composite = 10.9  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VI, IX and X.

\* Design Criteria Only



## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.050  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.021  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 8.2  $g_{rms}$

## Long. and Tang. Axis

20 Hz @ 0.0098  $g^2/Hz$   
20 - 87 Hz @ +3 dB/oct  
87 - 230 Hz @ 0.042  $g^2/Hz$   
230 - 250 Hz @ +6 dB/oct  
250 - 900 Hz @ 0.050  $g^2/Hz$   
900 - 970 Hz @ +15 dB/oct  
970 - 1500 Hz @ 0.070  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.050  $g^2/Hz$

Composite = 10.6  $g_{rms}$

Subzone 8-5 (Cont.)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.40  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.085  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.042  $g^2/Hz$

Composite = 16.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.039  $g^2/Hz$   
20 - 87 Hz @ +3 dB/oct  
87 - 230 Hz @ 0.17  $g^2/Hz$   
230 - 250 Hz @ +6 dB/oct  
250 - 900 Hz @ 0.20  $g^2/Hz$   
900 - 965 Hz @ -15 dB/oct  
965 - 1500 Hz @ 0.28  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.21  $g^2/Hz$

Composite = 21.2  $g_{rms}$

Subzone 8-5-1 SRB Forward Skirt Avionics Panels —  $\pm 135^\circ$  from Y axis  
opposite the ET (General Specifications)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.050  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.021  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 8.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.020  $g^2/Hz$   
155 - 300 Hz @ +6 dB/oct  
300 - 1500 Hz @ 0.070  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.050  $g^2/Hz$

Composite = 11.1  $g_{rms}$

Subzone 8-5-1 (Cont.)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.40  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.085  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.042  $g^2/Hz$

Composite = 16.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.080  $g^2/Hz$   
155 - 290 Hz @ +6 dB/oct  
290 - 1500 Hz @ 0.28  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.21  $g^2/Hz$

Composite = 22.2  $g_{rms}$

Subzone 8-5-1-A Input to SRB Forward Skirt Avionics Panels —  $\pm 135^\circ$  from Y axis  
opposite ET. Total Weight of Panel and Components < 80 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.020  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 300 Hz @ 0.10  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.021  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 8.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.020  $g^2/Hz$   
155 - 250 Hz @ +6 dB/oct  
250 - 400 Hz @ 0.050  $g^2/Hz$   
400 - 480 Hz @ -15 dB/oct  
480 - 750 Hz @ 0.021  $g^2/Hz$   
750 - 970 Hz @ +15 dB/oct  
970 - 1500 Hz @ 0.050  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 8.8  $g_{rms}$

Subzone 8-5-1-A (Cont.)

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 300 Hz @ 0.40  $g^2/Hz$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.085  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.042  $g^2/Hz$

Composite = 15.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @ 0.080  $g^2/Hz$   
 155 - 245 Hz @ +6 dB/oct  
 245 - 400 Hz @ 0.20  $g^2/Hz$   
 400 - 475 Hz @ -15 dB/oct  
 475 - 750 Hz @ 0.034  $g^2/Hz$   
 750 - 890 Hz @ +15 dB/oct  
 890 - 1500 Hz @ 0.20  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.15  $g^2/Hz$

Composite = 17.7  $g_{rms}$

Subzone 8-5-1-A-1 Input to Components mounted on the SRB Forward Skirt Avionics Panels -  $\pm 135^\circ$  from Y axis opposite the ET. Total Weight of Components on Panel <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.025  $g^2/Hz$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @ 0.10  $g^2/Hz$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.021  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010  $g^2/Hz$

Composite = 8.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @ 0.020  $g^2/Hz$   
 155 - 300 Hz @ +6 dB/oct  
 300 - 1500 Hz @ 0.070  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.050  $g^2/Hz$

Composite = 11.1  $g_{rms}$

Subzone 8-5-1-A-1 (Cont.)

2. Fast Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 40 Hz @ +6 dB/oct  
40 - 300 Hz @ 0.40  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.085  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.042  $g^2/oct$

Composite = 16.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.080  $g^2/Hz$   
155 - 290 Hz @ +6 dB/oct  
290 - 1500 Hz @ 0.28  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.21  $g^2/Hz$

Composite = 22.2  $g_{rms}$

Subzone 8-5-1-B Input to SRB Forward Skirt Avionics Panels -  $\pm 135^\circ$  from Y axis opposite the ET. Total Weight of Components  $\geq 80$  but  $< 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.020  $g^2/Hz$   
 20 - 88 Hz @ +3 dB/oct  
 88 - 300 Hz @ 0.088  $g^2/Hz$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.018  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0090  $g^2/Hz$

Composite = 7.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0085  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @ 0.017  $g^2/Hz$   
 155 - 250 Hz @ +6 dB/oct  
 250 - 400 Hz @ 0.042  $g^2/Hz$   
 400 - 480 Hz @ -15 dB/oct  
 480 - 750 Hz @ 0.018  $g^2/Hz$   
 750 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @ 0.042  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.032  $g^2/Hz$

Composite = 8.1  $g_{rms}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
 20 - 88 Hz @ +3 dB/oct  
 88 - 300 Hz @ 0.35  $g^2/Hz$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.074  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.036  $g^2/Hz$

Composite = 15.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.034  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @ 0.068  $g^2/Hz$   
 155 - 245 Hz @ +6 dB/oct  
 245 - 400 Hz @ 0.17  $g^2/Hz$   
 400 - 475 Hz @ -15 dB/oct  
 475 - 750 Hz @ 0.071  $g^2/Hz$   
 750 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @ 0.17  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.13  $g^2/Hz$

Composite = 16.3  $g_{rms}$

Subzone 8-5-1-B-1 Input to Components Mounted on the SRB Forward Skirt  
Avionics Panels —  $\pm 135^\circ$  from Y axis opposite the ET. Total  
 Weight of Components on Panel  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0092 \text{ g}^2/\text{Hz}$

Composite =  $7.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0085 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 155 - 300 Hz @ +6 dB/oct  
 300 - 1500 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.045 \text{ g}^2/\text{Hz}$

Composite =  $10.3 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.074 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.037 \text{ g}^2/\text{Hz}$

Composite =  $15.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.034 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @  $0.068 \text{ g}^2/\text{Hz}$   
 155 - 290 Hz @ +6 dB/oct  
 290 - 1500 Hz @  $0.24 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.18 \text{ g}^2/\text{Hz}$

Composite =  $20.6 \text{ g}_{\text{rms}}$

Subzone 8-5-1-C Input to SRB Forward Skirt Avionics Panels —  $\pm 135^\circ$  from Y axis  
opposite the ET. Total Weight of Panel and Components  $\geq 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.020  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 300 Hz @ 0.070  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.015  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.072  $g^2/Hz$

Composite = 6.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0065  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.012  $g^2/Hz$   
155 - 250 Hz @ +6 dB/oct  
250 - 400 Hz @ 0.032  $g^2/Hz$   
400 - 480 Hz @ -15 dB/oct  
480 - 750 Hz @ 0.014  $g^2/Hz$   
750 - 970 Hz @ +15 dB/oct  
970 - 1500 Hz @ 0.032  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.024  $g^2/Hz$

Composite = 7.1  $g_{rms}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 300 Hz @ 0.28  $g^2/Hz$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @ 0.060  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.029  $g^2/Hz$

Composite = 13.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.026  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 155 Hz @ 0.052  $g^2/Hz$   
155 - 245 Hz @ +6 dB/oct  
245 - 400 Hz @ 0.13  $g^2/Hz$   
400 - 475 Hz @ -15 dB/oct  
475 - 750 Hz @ 0.055  $g^2/Hz$   
750 - 970 Hz @ +15 dB/oct  
970 - 1500 Hz @ 0.13  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.095  $g^2/Hz$

Composite = 14.3  $g_{rms}$



Subzone 8-5-1-C-1 Input to Components Mounted on the SRB Forward Skirt Avionics Panels —  $\pm 135^\circ$  from Y axis opposite the ET. Total Weight of Components  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +6 dB/oct  
 27 - 300 Hz @  $0.070 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0072 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 155 - 300 Hz @ +6 dB/oct  
 300 - 1500 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.032 \text{ g}^2/\text{Hz}$

Composite =  $8.9 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +6 dB/oct  
 27 - 300 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.029 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 155 Hz @  $0.052 \text{ g}^2/\text{Hz}$   
 155 - 290 Hz @ +6 dB/oct  
 290 - 1500 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.13 \text{ g}^2/\text{Hz}$

Composite =  $17.8 \text{ g}_{\text{rms}}$

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.050  $g^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @ 0.050  $g^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.021  $g^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010  $g^2/\text{Hz}$

Composite = 8.2  $g_{\text{rms}}$ 

## Long. and Tang. Axes

20 Hz @ 0.0098  $g^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @ 0.042  $g^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @ 0.050  $g^2/\text{Hz}$   
 900 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @ 0.070  $g^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.050  $g^2/\text{Hz}$

Composite = 10.6  $g_{\text{rms}}$ 

## 2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

## Radial Axis

20 Hz @ 0.10  $g^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @ 0.40  $g^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @ 0.085  $g^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.042  $g^2/\text{Hz}$

Composite = 16.5  $g_{\text{rms}}$ 

## Long. and Tang. Axes

20 Hz @ 0.039  $g^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @ 0.17  $g^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @ 0.25  $g^2/\text{Hz}$   
 900 - 965 Hz @ +15 dB/oct  
 965 - 1500 Hz @ 0.28  $g^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.21  $g^2/\text{Hz}$

Composite = 21.2  $g_{\text{rms}}$

Subzone 8-5-2-A Input to SRB Forward Skirt Avionics Panels —  $\pm 45^\circ$  from Y axis adjacent to ET. Total Weight of Panel and Components <80 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 300 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $8.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0045 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 400 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 400 - 480 Hz @ -15 dB/oct  
 480 - 750 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
 750 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $8.9 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 300 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.085 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.042 \text{ g}^2/\text{Hz}$

Composite =  $16.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 230 - 255 Hz @ +6 dB/oct  
 255 - 400 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 400 - 475 Hz @ -15 dB/oct  
 475 - 750 Hz @  $0.084 \text{ g}^2/\text{Hz}$   
 750 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $17.9 \text{ g}_{\text{rms}}$

Subzone 8-5-2-A-1 Input to Component Mounted on the SRB Forward Skirt Avionics  
 Panels —  $\pm 45^\circ$  from  $\perp$  axis adjacent to ET. Total Weight of  
 Components on Panel <20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $8.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0098 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 900 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.070 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.050 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 300 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.085 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.042 \text{ g}^2/\text{Hz}$

Composite =  $16.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.039 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 900 - 965 Hz @ +15 dB/oct  
 965 - 1500 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.21 \text{ g}^2/\text{Hz}$

Composite =  $21.2 \text{ g}_{\text{rms}}$

Subzone 8-5-2-B     Input to SRB Forward Skirt Avionics Panels —  $\pm 45^\circ$  from Y axis  
adjacent to ET. Total weight of Panel and Components  $\geq 80$   
but  $< 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
20 - 88 Hz @ +3 dB/oct  
88 - 300 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0090 \text{ g}^2/\text{Hz}$

Composite =  $7.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0080 \text{ g}^2/\text{Hz}$   
20 - 87 Hz @ +3 dB/oct  
87 - 230 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
230 - 250 Hz @ +6 dB/oct  
250 - 400 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
400 - 480 Hz @ -15 dB/oct  
480 - 750 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
750 - 970 Hz @ +15 dB/oct  
970 - 1500 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.032 \text{ g}^2/\text{Hz}$

Composite =  $3.3 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
20 - 88 Hz @ +3 dB/oct  
88 - 300 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
300 - 650 Hz @ -6 dB/oct  
650 - 1400 Hz @  $0.074 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.036 \text{ g}^2/\text{Hz}$

Composite =  $15.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
20 - 87 Hz @ +3 dB/oct  
87 - 230 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
230 - 255 Hz @ +6 dB/oct  
255 - 400 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
400 - 475 Hz @ -15 dB/oct  
475 - 750 Hz @  $0.071 \text{ g}^2/\text{Hz}$   
750 - 890 Hz @ +15 dB/oct  
890 - 1500 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.13 \text{ g}^2/\text{Hz}$

Composite =  $16.6 \text{ g}_{\text{rms}}$

Subzone 8-5-2-E-1 Input to Components Mounted on the SRB Forward Skirt Avionics Panels —  $\pm 45^\circ$  from Y axis adjacent to ET. Total Weight of Components on Panel  $\geq 30$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0092 \text{ g}^2/\text{Hz}$

Composite =  $7.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0082 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 900 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.045 \text{ g}^2/\text{Hz}$

Composite =  $9.7 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.55 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.074 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.037 \text{ g}^2/\text{Hz}$

Composite =  $15.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 900 - 965 Hz @ +15 dB/oct  
 965 - 1500 Hz @  $0.24 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.1 \text{ g}^2/\text{Hz}$

Composite =  $19.5 \text{ g}_{\text{rms}}$

Subzone 8-5-2-C Input to SRB Forward Skirt Avionics Panels —  $\pm 45^\circ$  from Y axis adjacent to ET. Total Weight of Panel and Components  $\geq 120$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +3 dB/oct  
 70 - 300 Hz @  $0.070 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.072 \text{ g}^2/\text{Hz}$

Composite =  $6.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0062 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 400 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 400 - 480 Hz @ -15 dB/oct  
 480 - 750 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
 750 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $7.2 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +3 dB/oct  
 70 - 300 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.029 \text{ g}^2/\text{Hz}$

Composite =  $13.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 230 - 255 Hz @ +6 dB/oct  
 255 - 400 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 400 - 475 Hz @ -15 dB/oct  
 475 - 750 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
 750 - 890 Hz @ +15 dB/oct  
 890 - 1500 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.098 \text{ g}^2/\text{Hz}$

Composite =  $14.5 \text{ g}_{\text{rms}}$

Subzone 8-5-2-C-1 Input to Components Mounted on the SRB Forward Skirt Avionics Panels —  $\pm 45^\circ$  from Y axis adjacent to ET. Total Weight of Components  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +6 dB/oct  
 27 - 300 Hz @  $0.070 \text{ g}^2/\text{Hz}$   
 300 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0072 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0062 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 900 - 970 Hz @ +15 dB/oct  
 970 - 1500 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.035 \text{ g}^2/\text{Hz}$

Composite =  $8.5 \text{ g}_{\text{rms}}$

2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission on each axis)

Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +6 dB/oct  
 27 - 300 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 200 - 650 Hz @ -6 dB/oct  
 650 - 1400 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.029 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 20 - 87 Hz @ +3 dB/oct  
 87 - 230 Hz @  $0.11 \text{ g}^2$   
 230 - 250 Hz @ +6 dB/oct  
 250 - 900 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 900 - 965 Hz @ +15 dB/oct  
 965 - 1500 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.14 \text{ g}^2/\text{Hz}$

Composite =  $17.1 \text{ g}_{\text{rms}}$



Zone 9 SRB Nose Cone

Subzone 9-1 SRB Frustum - Stations 395-275 (General Specifications)

Same as Subzone 9-1-A below.

Subzone 9-1-A Input to Components Mounted on the SRB Frustum - Stations 395-275. Weight of Component <10 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 60 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
60 - 72 Hz @ -6 dB/oct  
72 - 600 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0014 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ -9 dB/oct

Composite =  $4.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 800 Hz @  $0.034 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00088 \text{ g}^2/\text{Hz}$

Composite =  $5.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
400 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

# 9-1-A (Cont.)

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @ 0.025  $g^2/Hz$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @ 0.090  $g^2/Hz$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0023  $g^2/Hz$

Composite = 9.2  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.0030  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @ 0.0060  $g^2/Hz$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @ 0.023  $g^2/Hz$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0023  $g^2/Hz$

Composite = 5.4  $g_{rms}$

## 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

### Radial Axis

20 - 60 Hz @ 0.30  $g^2/Hz$   
 60 - 72 Hz @ -6 dB/oct  
 72 - 600 Hz @ 0.20  $g^2/Hz$   
 600 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0055  $g^2/Hz$

Composite = 13.2  $g_{rms}$

### Long. and Tang. Axes

20 - 800 Hz @ 0.080  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0052  $g^2/Hz$

Composite = 9.5  $g_{rms}$

## 5. Vehicle Dynamics Criteria

### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
 5 - 10 Hz @ 0.7 G's peak  
 10 - 40 Hz @ 1.0 G's peak

### Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
 5 - 10 Hz @ 0.5 G's peak  
 10 - 40 Hz @ 4.3 G's peak

## 6. Shock Test Criteria (2 shocks/axis)

See Tables VIII, IX and X.

\* Design Criteria Only

Subzone 9-1-B

Input to Components Mounted on the SRB Frustum - Stations 395-275. Weight of Component  $\geq 10$  but  $< 25$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 50 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 50 - 62 Hz @ -6 dB/oct  
 62 - 600 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00088 \text{ g}^2/\text{Hz}$

Composite =  $3.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 20 - 28 Hz @ +3 dB/oct  
 28 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +3 dB/oct  
 27 - 120 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0016 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.0051 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0023 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

9-1-13 (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 50 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
50 - 62 Hz @ -6 dB/oct  
62 - 600 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0036 \text{ g}^2/\text{Hz}$

Composite =  $10.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.054 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0035 \text{ g}^2/\text{Hz}$

Composite =  $7.8 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VIII, IX and X.

\* Design Criteria Only

Subzone 9-1-C      Input to Components Mounted on the SRB Frustum - Stations  
395-275. Weight of Component  $\geq 25$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 40 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 40 - 50 Hz @ -6 dB/oct  
 50 - 600 Hz @  $0.021 \text{ g}^2/\text{Hz}$   
 600 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00058 \text{ g}^2/\text{Hz}$

Composite =  $4.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.0082 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.00052 \text{ g}^2/\text{Hz}$

Composite =  $3.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 20 - 28 Hz @ +3 dB/oct  
 28 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 120 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @  $0.039 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $6.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.0051 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0023 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

9-1-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 40 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @  $0.085 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0023 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0021 \text{ g}^2/\text{Hz}$

Composite =  $6.1 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Tables VIII, IX and X.

\* Design Criteria Only

Subzone 9-2            SRB Nose Cap — Stations 275-200 (General Specifications)

Same as Subzone 9-2-A below.

Subzone 9-2-A            Input to Components Mounted on the SRB Nose Cap — Stations 275-200. Weight of Component <10 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.75  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 1.50  $g^2/Hz$   
60 - 73 Hz @ -6 dB/oct  
73 - 250 Hz @ 1.00  $g^2/Hz$   
250 - 600 Hz @ -9 dB/oct  
600 - 1000 Hz @ 0.075  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0048  $g^2/Hz$

Composite = 20.0  $g_{rms}$

Long. and Tang. Axes

20 - 250 Hz @ 0.38  $g^2/Hz$   
250 - 430 Hz @ -9 dB/oct  
430 - 1000 Hz @ 0.075  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0048  $g^2/Hz$

Composite = 13.4  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.22  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 800 Hz @ 0.44  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 21.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.055  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 1100 Hz @ 0.11  $g^2/Hz$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 12.3  $g_{rms}$

9-2-A (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.15  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @ 0.30  $g^2/Hz$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @ 1.00  $g^2/Hz$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.025  $g^2/Hz$

Composite = 30.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.038  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @ 0.075  $g^2/Hz$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @ 0.25  $g^2/Hz$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.023  $g^2/Hz$

Composite = 18.0  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 3.00  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 60 Hz @ 6.00  $g^2/Hz$   
 60 - 73 Hz @ -6 dB/oct  
 73 - 250 Hz @ 4.00  $g^2/Hz$   
 250 - 600 Hz @ -9 dB/oct  
 600 - 1000 Hz @ 0.30  $g^2/Hz$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.019  $g^2/Hz$

Composite = 40.1  $g_{rms}$

Long. and Tang. Axes

20 - 250 Hz @ 1.50  $g^2/Hz$   
 250 - 430 Hz @ -9 dB/oct  
 430 - 1000 Hz @ 0.30  $g^2/Hz$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.019  $g^2/Hz$

Composite = 26.9  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
 5 - 10 Hz @ 0.7 G's peak  
 10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
 5 - 10 Hz @ 0.5 G's peak  
 10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Table VIII.

\* Design Criteria Only



## Subzone 9-2-B

Input to Components Mounted on the SRB Nose Cap — Stations  
275-200. Weight of Component  $\geq 10$  but  $< 25$  lb.

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +3 dB/oct  
 27 - 50 Hz @  $1.00 \text{ g}^2/\text{Hz}$   
 50 - 63 Hz @ -6 dB/oct  
 63 - 250 Hz @  $0.65 \text{ g}^2/\text{Hz}$   
 250 - 600 Hz @ -9 dB/oct  
 600 - 1000 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0032 \text{ g}^2/\text{Hz}$

Composite =  $16.2 \text{ g}_{\text{rms}}$ 

## Long. and Tang. Axes

20 - 250 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 250 - 430 Hz @ -9 dB/oct  
 430 - 1000 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0032 \text{ g}^2/\text{Hz}$

Composite =  $11.0 \text{ g}_{\text{rms}}$ 

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Radial Axis

20 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
 20 - 28 Hz @ +3 dB/oct  
 28 - 800 Hz @  $0.29 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0075 \text{ g}^2/\text{Hz}$

Composite =  $17.3 \text{ g}_{\text{rms}}$ 

## Long. and Tang. Axes

20 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
 20 - 28 Hz @ +3 dB/oct  
 28 - 1100 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0070 \text{ g}^2/\text{Hz}$

Composite =  $10.2 \text{ g}_{\text{rms}}$ 

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

## Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 27 Hz @ +3 dB/oct  
 27 - 120 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @  $0.66 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.017 \text{ g}^2/\text{Hz}$

Composite =  $24.9 \text{ g}_{\text{rms}}$ 

## Long. and Tang. Axes

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.016 \text{ g}^2/\text{Hz}$

Composite =  $14.8 \text{ g}_{\text{rms}}$

9-2-B (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 3.00  $g^2/Hz$   
20 - 27 Hz @ +3 dB/oct  
27 - 50 Hz @ 4.00  $g^2/Hz$   
50 - 63 Hz @ -6 dB/oct  
63 - 250 Hz @ 2.60  $g^2/Hz$   
250 - 600 Hz @ -9 dB/oct  
600 - 1000 Hz @ 0.20  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite - 32.5  $g_{rms}$

Long. and Tang. Axes

20 - 250 Hz @ 1.00  $g^2/Hz$   
250 - 430 Hz @ -9 dB/oct  
430 - 1000 Hz @ 0.20  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ -12 dB/oct

Composite = 22.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Table VIII.

\* Design Criteria Only

## Subzone 9-2-C

Input to Components Mounted on the SRB Nose Cap — Stations  
275-200. Weight of Component  $\geq 25$  lb.

## 1. Acceptance Test Criteria (1 min/axis)

## Radial Axes

20 - 40 Hz @  $0.65 \text{ g}^2/\text{Hz}$   
 40 - 50 Hz @ -6 dB/oct  
 50 - 250 Hz @  $0.42 \text{ g}^2/\text{Hz}$   
 250 - 600 Hz @ -9 dB/oct  
 600 - 1000 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $12.9 \text{ g}_{\text{rms}}$

## Long. and Tang. Axes

20 - 250 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 250 - 430 Hz @ -9 dB/oct  
 430 - 1000 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0020 \text{ g}^2/\text{Hz}$

Composite =  $8.7 \text{ g}_{\text{rms}}$

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

## Radial Axis

20 - 800 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $14.0 \text{ g}_{\text{rms}}$

## Long. and Tang. Axes

20 - 1100 Hz @  $0.048 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $8.2 \text{ g}_{\text{rms}}$

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

## Radial Axis

20 - 120 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 800 Hz @  $0.43 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.011 \text{ g}^2/\text{Hz}$

Composite =  $20.1 \text{ g}_{\text{rms}}$

## Long. and Tang. Axes

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 120 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 120 - 180 Hz @ +9 dB/oct  
 180 - 1100 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $11.9 \text{ g}_{\text{rms}}$

9-2-C (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 40 Hz @  $2.60 \text{ g}^2/\text{Hz}$   
40 - 50 Hz @ -6 dB/oct  
50 - 250 Hz @  $1.70 \text{ g}^2/\text{Hz}$   
250 - 600 Hz @ -9 dB/oct  
600 - 1000 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0076 \text{ g}^2/\text{Hz}$

Composite =  $25.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 250 Hz @  $0.63 \text{ g}^2/\text{Hz}$   
250 - 430 Hz @ -9 dB/oct  
430 - 1000 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0080 \text{ g}^2/\text{Hz}$

Composite =  $17.5 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

See Table VIII.

\* Design Criteria Only

### SECTION III. SHOCK SPECIFICATIONS

#### PYROTECHNIC SHOCK SPECTRUM CRITERIA FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE

##### SHOCK SPECTRUM

50 Hz @ A G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ B G's peak  
100 - 4000 Hz @ +6 dB/oct  
4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

TABLE I. DELETED

DELETED				
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TABLE II. SRB NOZZLE

Shock Source	SkB Station Number ( $X_b$ ) of Component (in.)	Spectrum Amplitudes		
		A	B	C
Nozzle Severance	$1989.6 \geq X_b > 1970.6$	235	938	37,500
	$1970.6 \geq X_b > 1947.2$	469	1,875	75,000
	$1947.2 \geq X_b > 1935.5$	938	3,750	150,000
	$1935.5 \geq X_b > 1912.3$	1,875	7,500	300,000
	$1912.3 \geq X_b > 1901.3$	938	3,750	150,000
	$1901.3 \geq X_b > 1884.7$	469	1,875	75,000
	$1884.7 \geq X_b > 1879.0$	332	1,325	53,000
	$1879.0 \geq X_b > 1833.8$	166	662	26,500

**PYROTECHNIC SHOCK SPECTRUM CRITERIA**  
**FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE**

**SHOCK SPECTRUM**

50 Hz @ A G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ B G's peak  
100 - 4000 Hz @ +6 dB/oct  
4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

TABLE III. SRB AFT SKIRT

Shock Source	D = Distance from Component to Actuator/Aft Skirt Attach Point (in.)	Spectrum Amplitudes		
		A	B	C
Nozzle Severance	$0 < D \leq 36$	30	117	4,688
	$36 < D \leq 132$	15	59	2,344
	$132 < D \leq 324$	8	29	1,172
	$324 < D$	N/A	N/A	N/A
	D = Distance from Component to SRB Hold-down Point (in.)			
SRB Release At Lift-off (Hold-Down)	$0 < D \leq 12$	94	375	15,000
	$12 < D \leq 24$	47	188	7,500
	$24 < D \leq 48$	24	94	3,750
	$48 < D \leq 96$	12	47	1,875
	$96 < D$	N/A	N/A	N/A

TABLE IV. SRB FUEL CYLINDER AND BULKHEADS

Shock Source	SRB Station Number ( $X_b$ ) of Component (in.)	Spectrum Amplitudes		
		A	B	C
Nozzle Severance	$1875 > X_b \geq 1733$	8	29	1,172
	$1733 > X_b \geq 486.3$	N/A	N/A	N/A
	D = Distance from Component to ET/SRB Aft Attach Point (in.)			
Aft Attach Bolts	$0 < D \leq 33$	24	94	3,750
	$33 < D \leq 81$	12	47	1,875
	$81 < D$	N/A	N/A	N/A

**PYROTECHNIC SHOCK SPECTRUM CRITERIA**  
**FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE**

**SHOCK SPECTRUM**

50 - 50 Hz @ A G's peak  
 100 - 100 Hz @ +12 dB/oct  
       100 Hz @ B G's peak  
 100 - 4000 Hz @ +6 dB/oct  
 4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

**TABLE V. SRB FORWARD SKIRT**

Shock Source	SRB Station Number ( $X_b$ ) of Component (in.)	Spectrum Amplitudes		
		A	B	C
Fwd Skirt/ Frustum Separation	395 < $X_b$ ≤ 407	188	750	30.000
	407 < $X_b$ ≤ 419	94	375	15.000
	419 < $X_b$ ≤ 443	47	188	7.500
	443 < $X_b$ ≤ 491	24	94	3.750
	491 < $X_b$ ≤ 530.5	12	47	1.875
	530.5 < $X_b$	N/A	N/A	N/A
D = Distance from Component to ET/SRB Fwd Attach Point (in.)				
Fwd Attach Bolt	0 < D ≤ 12	94	375	15.000
	12 < D ≤ 24	47	188	7.500
	24 < D ≤ 48	24	94	3.750
	48 < D ≤ 96	12	47	1.875
	96 < D	N/A	N/A	N/A

**PYROTECHNIC SHOCK SPECTRUM CRITERIA**  
**FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE**

**SHOCK SPECTRUM**

ORIGINAL PAGE IS  
OF POOR QUALITY

50 Hz @ A G's peak  
 50 - 100 Hz @ +12 dB/oct  
 100 Hz @ B G's peak  
 100 - 4000 Hz @ +6 dB/oct  
 4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

TABLE VI. PANELS IN THE SRB FORWARD SKIRT

Shock Source	SRB Station Number ( $X_b$ ) of Component	Spectrum Amplitudes		
		A	B	C
Fwd Skirt/ Frustum Separation	$395 < X_b \leq 407$	94	325	15,000
	$407 < X_b \leq 419$	47	188	7,500
	$419 < X_b \leq 443$	24	94	3,750
	$443 < X_b \leq 491$	12	47	1,875
	$491 < X_b \leq 530.5$	N/A	N/A	N/A
D = Distance from Component to ET/SRB Fwd Attach Point (in.)				
Fwd Attach Bolt	$0 < D \leq 12$	47	188	7,500
	$12 < D \leq 24$	24	94	3,750
	$24 < D \leq 48$	12	47	1,875
	$48 < D$	N/A	N/A	N/A

TABLE VII. SRB FORWARD SKIRT BULKHEAD

Shock Source	D = Distance to Component from SRB Nose Cone Separation Plane (in.)	Spectrum Amplitudes		
		A	B	C
Fwd Skirt/ Frustum Separation	$0 < D \leq 12$	188	750	30,000
	$12 < D \leq 24$	94	375	15,000
	$24 < D \leq 48$	47	188	7,500
	$48 < D \leq 96$	24	94	3,750
	$96 < D$	N/A	N/A	N/A



**PYROTECHNIC SHOCK SPECTRUM CRITERIA**  
**FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE**

**SHOCK SPECTRUM**

50 Hz @ A G's peak  
 50 - 100 Hz @ +12 dB/oct  
       100 Hz @ B G's peak  
 100 - 4000 Hz @ +6 dB/oct  
 4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

TABLE VIII. SRB NOSE CONE

Shock Source	SRB Station Number ( $X_b$ ) of Component	Spectrum Amplitudes		
		A	B	C
Fwd Skirt/ Frustum Separation	395 $X_b \geq 383$	188	750	30,000
	383 $X_b \geq 371$	94	375	15,000
	371 $X_b \geq 347$	47	188	7,500
	347 $X_b \geq 299$	24	94	3,750
	299 $X_b \geq 275$	12	47	1,875
	275 $X_b$	N/A	N/A	N/A

**TABLE IX. SRB WATER LANDING SHOCK TEST CRITERIA**  
(2 shocks/axis/mission)

SRB		Half-Sine Shock Pulse			
		Longitudinal		Lateral	
Subzone	Structure	Amplitude (G's peak)	Duration (msec)	Amplitude (G's peak)	Duration (msec)
9-3	Nose Cap	N/A	N/A	N/A	N/A
9-2	Frustum-Fwd	40	50	15	100
9-1	Frustum-Aft	40	50	15	100
8-5	Forward Skirt - Avionics Panels	20	150	22	100
8-4	Forward Skirt - Bulkhead	20	150	22	100
8-3	Forward Skirt - Forward	20	150	22	100
8-2	Forward Skirt - Mid	20	150	22	100
8-1	Forward Skirt - Aft	20	150	22	100
7-4	Forward Fuel Cylinder Bulkhead	20	150	22	100
7-3	Forward Fuel Cylinder	20	150	8	100
7-2	Aft Fuel Cylinder	20	150	8	100
7-1	Aft Fuel Cylinder Bulkhead	20	150	30	100
6-2	Aft Skirt	20	150	30	100
6-1	Nozzle	20	150	30	100

Note: Both shocks for the Longitudinal direction shall be applied in the flight direction.

TABLE X. SRB PARACHUTE DEPLOYMENT SHOCK TEST CRITERIA  
(2 shocks/axis/mission)

SRB		Half-Sine Shock Pulse			
		Longitudinal		Lateral	
Subzone	Structure	Amplitude (G's peak)	Duration (msec)	Amplitude (G's peak)	Duration (msec)
9-3	Nose Cap	N/A	N/A	N/A	N/A
9-2	Frustum - Fwd	1.0	300	5.7	300
9-1	Frustum - Aft	1.0	300	5.7	300
8-5	Forward Skirt - Avionics Panels	3.6	300	4.6	300
8-4	Forward Skirt - Bulkhead	3.6	300	5.7	300
8-3	Forward Skirt - Forward	3.6	300	4.6	300
8-2	Forward Skirt - Mid	3.6	300	4.6	300
8-1	Forward Skirt - Aft	3.6	300	4.6	300
7-4	Forward Fuel Cylinder Bulkhead	3.6	300	4.6	300
7-3	Forward Fuel Cylinder	3.6	500	1.7	300
7-2	Aft Fuel Cylinder	3.6	500	1.7	300
7-1	Aft Fuel Cylinder Bulkhead	3.6	300	3.4	300
6-2	Aft Skirt	3.6	300	3.4	300
6-1	Nozzle	3.6	300	3.4	300

# SECTION IV. ACOUSTIC TEST SPECIFICATIONS

## Subzone 6-1 - SRB Nozzle - Stations 1990-1830 (General Specifications)

### INTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0				153.5
6.3				154.5
8.0				156.5
10.0	N	N	N	158.5
12.5				159.0
16.0	O	O	O	164.0
20.0				169.5
25.0	T	T	T	165.0
31.5				162.5
40.0				164.0
50.0				164.0
63.0				166.0
80.0	A	A	A	166.5
100.0				165.0
125.0	P	P	P	173.0
160.0				177.5
200.0	P	P	P	167.0
250.0				167.0
315.0	L	L	L	171.0
400.0				165.5
500.0	I	I	I	164.5
630.0				164.0
800.0	C	C	C	163.0
1000.0				162.0
1250.0	A	A	A	161.0
1600.0				160.0
2000.0	B	B	B	159.0
2500.0				158.0
3150.0	L	L	L	157.0
4000.0				156.0
5000.0	E	E	E	155.0
6300.0				154.0
8000.0				153.0
10000.0				152.0
Overall SPL	N/A	N/A	N/A	182.0
Duration	N/A	N/A	N/A	60 sec plus 30 sec per mission

Subzone 6-1 - SRB Nozzle - Stations 1990-1830 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	132.0	146.0		153.0
6.3	133.0	147.0		156.0
8.0	134.0	149.0	N	157.5
10.0	135.5	149.0		161.0
12.5	137.0	150.0	O	158.0
16.0	138.0	151.0		157.5
20.0	139.5	151.5	T	159.5
25.0	141.0	151.5		158.0
31.5	142.0	152.0		157.0
40.0	143.5	152.0	A	157.5
50.0	144.5	152.0		157.5
63.0	145.5	152.0	P	157.5
80.0	146.0	152.0		156.5
100.0	146.5	152.0	P	156.0
125.0	147.0	152.0		157.0
160.0	147.5	151.5	L	157.5
200.0	147.5	151.0		157.5
250.0	147.5	151.0	I	156.5
315.0	147.0	150.5		159.5
400.0	147.0	150.0	C	157.0
500.0	146.5	149.5		155.5
630.0	146.0	149.0	A	154.0
800.0	145.5	148.5		154.0
1000.0	145.0	148.0	B	153.0
1250.0	144.5	147.0		152.0
1600.0	144.0	146.5	L	151.0
2000.0	143.5	145.5		150.0
2500.0	143.0	145.5	E	149.0
3150.0	142.0	144.0		148.0
4000.0	141.0	143.0		147.0
5000.0	140.0	142.0		146.0
6300.0	139.0	141.0		145.0
8000.0	138.0	140.0		144.0
10000.0	137.0	139.0		143.0
Overall SPL	159.5	165.0		172.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 6-2 — SRB Aft Skirt — Stations 1930-1837 (General Specifications)

INTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0				134.0
6.3				136.0
8.0				141.5
10.0	N	N	N	143.0
12.5				139.0
16.0	O	O	O	137.0
20.0				136.5
25.0	T	T	T	135.0
31.5				133.0
40.0				134.0
50.0				134.5
63.0				134.0
80.0	A	A	A	134.0
100.0				135.5
125.0	P	P	P	141.0
160.0				143.5
200.0	P	P	P	138.0
250.0				137.5
315.0	L	L	L	137.5
400.0				137.5
500.0	I	I	I	137.5
630.0				137.0
800.0	C	C	C	137.0
1000.0				136.5
1250.0	A	A	A	135.5
1600.0				134.5
2000.0	B	B	B	133.5
2500.0				132.5
3150.0	L	L	L	131.5
4000.0				130.5
5000.0	E	E	E	129.5
6300.0				128.5
8000.0				127.5
10000.0				126.5
Overall SPL	N/A	N/A	N/A	152.5
Duration	N/A	N/A	N/A	60 sec plus 30 sec per mission

Subzone 6-2 - SRB Aft Skirt - Stations 1930-1837 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	132.0	146.0		140.5
6.3	133.0	147.0		152.0
8.0	134.0	148.0		143.0
10.0	135.5	149.0	N	144.0
12.5	137.0	150.0		145.0
16.0	138.0	151.0	O	146.0
20.0	139.5	151.5		147.0
25.0	141.0	151.5	T	148.5
31.5	142.0	152.0		149.5
40.0	143.5	152.0		150.5
50.0	144.5	152.0		151.5
63.0	145.5	152.0	A	153.0
80.0	146.0	152.0		154.0
100.0	146.5	152.0	P	155.0
125.0	147.0	152.0		155.0
160.0	147.5	151.5	P	155.0
200.0	147.5	151.0		155.0
250.0	147.5	151.0	L	155.0
315.0	147.0	150.5		154.0
400.0	147.0	150.0		153.0
500.0	146.5	149.5		152.5
630.0	146.0	149.0	C	151.5
800.0	145.5	148.5		150.5
1000.0	145.0	148.0	A	149.5
1250.0	144.5	147.0		148.5
1600.0	144.0	146.5	B	147.0
2000.0	143.5	145.5		145.0
2500.0	143.0	145.0	L	144.0
3150.0	142.0	144.0		143.5
4000.0	141.0	143.0	E	142.0
5000.0	140.0	142.0		140.0
6300.0	139.0	141.0		139.0
8000.0	138.0	140.0		137.5
10000.0	137.0	139.0		136.0
Overall SPL	159.5	165.0		166.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 7-1 - SRB Aft Fuel Bulkhead - Stations 1875-1818 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0				134.0
6.3				136.0
8.0				141.5
10.0	N	N	N	143.0
12.5				139.0
16.0	O	O	O	137.0
20.0				136.5
25.0	T	T	T	135.0
31.5				133.0
40.0				134.0
50.0				134.5
63.0				134.0
80.0	A	A	A	134.0
100.0				135.5
125.0	P	P	P	141.0
160.0				143.5
200.0	P	P	P	138.0
250.0				137.5
315.0	L	L	L	137.5
400.0				137.5
500.0	I	i	I	137.5
630.0				137.0
800.0	C	C	C	137.0
1000.0				136.5
1250.0	A	A	A	135.5
1600.0				134.5
2000.0	B	B	B	133.5
2500.0				132.5
3150.0	L	L	L	131.5
4000.0				130.5
5000.0	E	E	E	129.5
6300.0				128.5
8000.0				127.5
10000.0				126.5
Overall SPL				152.5
Duration				60 sec plus 30 sec per mission



Subzone 7-2 — SRB Aft Fuel Cylinder — Stations 1837-1180 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	132.0	149.0		151.5
6.3	133.0	150.0		152.5
8.0	134.0	151.0		153.5
10.0	135.5	152.0	N	154.5
12.5	137.0	153.0		155.5
16.0	138.0	154.0	O	156.5
20.0	139.5	154.5		157.5
25.0	141.0	155.5	T	158.5
31.5	142.0	156.5		159.5
40.0	143.5	157.0		160.5
50.0	144.5	157.5		162.0
63.0	145.5	158.0	A	162.5
80.0	146.0	158.5		163.5
100.0	146.5	158.5	P	164.0
125.0	147.0	159.0		164.0
160.0	147.5	158.5	P	164.5
200.0	147.5	158.0		164.5
250.0	147.5	157.5	L	163.5
315.0	147.0	157.0		163.0
400.0	147.0	156.0	I	162.0
500.0	146.5	155.0		161.0
630.0	146.0	154.0	C	160.0
800.0	145.5	152.5		159.0
1000.0	145.0	151.5	A	158.0
1250.0	144.5	150.0		157.0
1600.0	144.0	148.0	B	156.0
2000.0	143.5	147.0		155.0
2500.0	143.0	145.0	L	154.0
3150.0	142.0	143.0		153.0
4000.0	141.0	141.0	E	152.0
5000.0	140.0	139.0		151.0
6300.0	139.0	137.0		150.0
8000.0	138.0	136.0		149.0
10000.0	137.0	135.0		148.0
Overall SPL	159.5	170.0		175.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 7-2-1 — SRB/ET Attach Ring — Station 1511 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	132.0	149.0		148.0
6.3	133.0	150.0		149.0
8.0	134.0	151.0		150.0
10.0	135.5	152.0	N	151.5
12.5	137.0	153.0		152.5
16.0	138.0	154.0	O	153.5
20.0	139.5	154.5		154.5
25.0	141.0	155.0	T	156.0
31.5	142.0	155.5		157.0
40.0	143.5	156.0		158.0
50.0	144.5	156.0		159.0
63.0	145.5	156.0		160.5
80.0	146.0	156.5	A	161.5
100.0	146.5	156.5		162.0
125.0	147.0	156.0	P	162.5
160.0	147.5	155.0		163.0
200.0	147.5	155.0	P	163.0
250.0	147.5	154.5		163.0
315.0	147.0	154.0	L	163.0
400.0	147.0	153.0		162.5
500.0	146.5	152.0	I	161.5
630.0	146.0	151.0		161.0
800.0	145.5	150.0	C	159.5
1000.0	145.0	149.0		158.5
1250.0	144.5	148.0	A	157.5
1600.0	144.0	146.5		156.5
2000.0	143.5	145.0	B	155.0
2500.0	143.0	143.5		154.0
3150.0	142.0	142.0	L	153.0
4000.0	141.0	140.5		152.0
5000.0	140.0	138.5	E	151.0
6300.0	139.0	137.0		150.0
8000.0	138.0	136.0		149.0
10000.0	137.0	135.0		148.0
Overall SPL	159.5	167.0		174.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 7-3 — SRB Forward Fuel Cylinder — Stations 1180-524 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	133.0	149.0		147.0
6.3	134.0	150.0		149.0
8.0	135.0	151.0		151.5
10.0	136.0	152.0	N	153.0
12.5	137.5	153.0		154.0
16.0	138.0	154.0	O	153.0
20.0	139.0	168.0		151.5
25.0	140.0	168.0	T	151.0
31.5	141.5	168.0		151.0
40.0	142.0	161.0		151.5
50.0	143.0	161.0		153.0
63.0	144.0	161.0		154.5
80.0	144.5	154.0	A	156.0
100.0	144.5	153.5		157.0
125.0	144.5	153.0	P	157.5
160.0	144.5	152.5		156.0
200.0	144.5	152.0	P	154.0
250.0	144.5	151.5		153.0
315.0	144.0	151.0	L	151.0
400.0	144.0	150.0		149.0
500.0	143.0	149.0	I	147.0
630.0	142.5	148.0		145.0
800.0	142.0	147.0	C	142.5
1000.0	141.5	146.0		140.0
1250.0	140.5	145.0	A	138.5
1600.0	140.0	144.0		136.5
2000.0	139.0	143.0	B	134.5
2500.0	138.5	142.0		132.5
3150.0	137.5	141.0	L	130.5
4000.0	136.0	140.0		128.5
5000.0	135.0	139.0	E	127.0
6300.0	134.0	138.0		125.0
8000.0	133.5	137.0		123.0
10000.0	132.5	136.0		121.0
Overall SPL	156.5	174.0		167.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Suezzone 7-4 — SRB Forward Fuel Bulkhead — Stations 531-486 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	106.0	112.0		123.0
6.3	108.5	114.0		126.0
8.0	110.5	116.5		129.0
10.0	113.0	118.5	N	131.5
12.5	115.5	121.0		134.0
16.0	117.5	123.0	O	135.5
20.0	119.5	134.0		137.5
25.0	121.5	135.0	T	137.5
31.5	123.5	139.0		138.0
40.0	125.5	140.5		139.0
50.0	127.5	133.5		139.0
63.0	129.0	133.0		139.5
80.0	131.0	135.0	A	140.0
100.0	132.5	136.0		140.5
125.0	133.5	137.5	P	141.0
160.0	134.5	138.5		141.0
200.0	134.5	139.0	P	141.5
250.0	134.0	139.0		141.5
315.0	134.0	139.0	L	141.5
400.0	132.5	138.0		140.5
500.0	131.0	137.0	I	139.0
630.0	129.0	136.0		137.0
800.0	127.5	134.5	C	134.5
1000.0	126.0	133.5		133.0
1250.0	124.0	132.5	A	130.5
1600.0	122.0	131.0		128.0
2000.0	120.5	130.0	B	126.0
2500.0	118.5	128.5		123.5
3150.0	116.0	127.0	L	120.5
4000.0	113.5	125.0		117.5
5000.0	111.5	123.5	E	115.0
6300.0	108.5	121.5		111.5
8000.0	106.0	119.5		109.0
10000.0	104.0	118.0		106.5
Overall SPL	144.0	150.0		152.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Zone 8 - SRB Forward Skirt - Stations 524-395 (General Specifications)

INTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N}/\text{m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	106.0	112.0		123.0
6.3	108.5	114.0		126.0
8.0	110.5	116.5		129.0
10.0	113.0	118.5	N	131.5
12.5	115.5	121.0		134.0
16.0	117.5	123.0	O	135.5
20.0	119.5	134.0		137.5
25.0	121.5	135.0	T	137.5
31.5	123.5	139.0		138.0
40.0	125.5	140.5		139.0
50.0	127.5	133.5		139.0
63.0	129.0	133.0		139.5
80.0	131.0	135.0	A	140.0
100.0	132.5	136.0		140.5
125.0	133.5	137.5	P	141.0
160.0	134.5	138.5		141.5
200.0	134.5	139.0	P	141.5
250.0	134.0	139.0		141.5
315.0	134.0	139.0	L	141.5
400.0	132.5	138.0		140.5
500.0	131.0	137.0	I	139.0
630.0	129.5	136.0		137.0
800.0	127.5	134.5	C	134.5
1000.0	126.0	133.5		133.0
1250.0	124.0	132.5	A	130.5
1600.0	122.0	131.0		128.5
2000.0	120.5	130.0	B	126.0
2500.0	118.5	128.5		123.5
3150.0	116.0	127.0	L	120.5
4000.0	115.5	125.0		117.5
5000.0	111.5	123.5	E	115.0
6300.0	108.5	121.5		111.5
8000.0	106.0	119.5		109.0
10000.0	104.0	118.0		106.5
Overall SPL	144.0	150.0		152.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 8-1 - SRB Forward Skirt - Stations 524-485 (General Specifications)  $\pm 45^\circ$   
from Y Axis Adjacent ET

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	131.0	146.0	146.5	148.0
6.3	132.5	147.0	146.0	150.0
8.0	133.0	148.0	145.0	152.5
10.0	134.5	149.0	144.0	154.5
12.5	135.5	150.0	143.0	155.5
16.0	136.5	151.0	141.5	156.0
20.0	137.5	163.0	140.0	157.0
25.0	138.5	163.0	137.5	156.0
31.5	139.5	166.0	135.0	155.0
40.0	140.0	166.0	133.0	154.0
50.0	141.0	156.0	130.5	153.0
63.0	141.5	152.0	128.0	152.0
80.0	142.0	151.5	125.0	150.5
100.0	142.5	151.0	122.0	150.0
125.0	142.5	150.5	119.5	149.5
160.0	142.5	150.0	116.0	149.5
200.0	142.5	149.0	113.0	148.5
250.0	142.0	148.0	109.0	147.0
315.0	142.0	147.5	106.0	146.0
400.0	141.5	146.0	103.0	144.0
500.0	141.0	145.5	100.0	143.0
630.0	140.5	144.0	97.0	141.5
800.0	139.5	143.0	94.0	140.0
1000.0	139.0	142.0	91.0	138.5
1250.0	138.0	141.0	88.0	137.5
1600.0	137.0	140.0	84.0	136.0
2000.0	136.5	138.5	81.0	134.5
2500.0	135.5	137.5	78	133.5
3150.0	134.5	136.0	75	131.5
4000.0	133.5	134.5	72	130.0
5000.0	132.5	133.5	69.0	128.5
6300.0	131.0	132.0	66.0	127.0
8000.0	130.0	131.0	63.0	126.0
10000.0	129.0	130.0	60.0	124.5
Overall SPL	154.5	171.0	157.0	166.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

Subzone 8-1 - SRB Forward Skirt - Stations 521-485 (General Specifications)  $\pm 135^\circ$   
from Y Axis Opposite ET

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	131.0	128.0	146.5	148.0
6.3	132.5	129.0	146.0	150.0
8.0	133.0	130.0	145.0	152.5
10.0	134.5	131.0	144.0	154.5
12.5	135.5	132.0	143.0	155.5
16.0	136.5	133.0	141.5	156.0
20.0	137.5	134.0	140.0	157.0
25.0	138.5	135.0	137.5	156.0
31.5	139.5	136.0	135.0	155.0
40.0	140.0	137.0	133.0	154.0
50.0	141.0	137.5	130.5	153.0
63.0	141.5	138.0	128.0	152.0
80.0	142.0	139.0	125.0	150.5
100.0	142.5	139.5	122.0	150.0
125.0	142.5	140.0	119.5	149.5
160.0	142.5	140.5	116.0	149.5
200.0	142.5	141.0	113.0	148.5
250.0	142.0	141.0	109.0	147.0
315.0	142.0	141.5	106.0	146.0
400.0	141.5	141.5	103.0	144.0
500.0	141.0	141.5	100.0	143.0
630.0	140.5	142.0	97.0	141.5
800.0	139.5	142.0	94.0	140.0
1000.0	139.0	142.0	91.0	138.5
1250.0	138.0	142.0	88.0	137.5
1600.0	137.0	141.5	84.0	136.0
2000.0	136.5	141.5	81.0	134.5
2500.0	135.5	141.5	78.0	133.5
3150.0	134.5	141.0	75.0	131.5
4000.0	133.5	141.0	72.0	130.0
5000.0	132.5	140.5	69.0	128.5
6300.0	131.0	140.0	66.0	127.0
8000.0	130.0	139.5	63.0	126.0
10000.0	129.0	139.0	60.0	124.5
Overall SPL	154.5	155.0	157.0	166.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

Subzone 8-2 — SRB Forward Skirt — Stations 484-434 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	131.0	132.0	159.0	148.0
6.3	132.5	133.0	159.5	150.0
8.0	133.0	134.0	160.0	151.5
10.0	134.5	135.0	160.0	153.0
12.5	135.5	136.0	160.0	153.5
16.0	136.5	137.0	160.0	154.5
20.0	137.5	138.0	159.0	155.0
25.0	138.5	139.0	158.0	154.5
31.5	139.5	140.0	157.0	154.0
40.0	140.0	141.0	155.5	153.5
50.0	141.0	141.5	154.0	152.5
63.0	141.5	142.0	152.0	152.0
80.0	142.0	142.5	151.0	151.0
100.0	142.5	143.0	148.5	150.0
125.0	142.5	143.5	146.5	149.0
160.0	142.5	144.0	144.0	148.0
200.0	142.5	144.5	142.0	147.0
250.0	142.0	145.0	140.0	146.0
315.0	142.0	145.0	137.0	145.0
400.0	141.5	145.5	134.0	144.0
500.0	141.0	145.5	131.0	143.0
630.0	140.5	145.5	128.0	141.5
800.0	139.5	145.5	125.0	140.0
1000.0	139.0	145.5	122.0	138.5
1250.0	138.0	145.5	119.0	137.5
1600.0	137.0	145.5	116.0	135.5
2000.0	136.5	145.5	113.0	134.5
2500.0	135.5	145.5	110.0	133.0
3150.0	134.5	145.5	107.0	131.5
4000.0	133.5	145.0	104.0	130.0
5000.0	132.5	144.5	101.0	128.5
6300.0	131.0	144.0	98.0	127.0
8000.0	130.0	143.5	95.0	126.0
10000.0	129.0	143.0	92.0	124.5
Overall SPL	154.5	159.0	170.0	165.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission



Subzone 8-3 - SRB Forward Skirt - Stations 433-395 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	131.0	134.0	154.0	148.0
6.3	132.5	135.0	155.0	149.0
8.0	133.0	136.0	155.5	150.5
10.0	134.5	137.0	156.0	151.5
12.5	135.5	138.0	156.5	152.0
16.0	136.5	139.0	157.0	152.5
20.0	137.5	140.0	157.0	153.0
25.0	138.5	141.0	156.5	153.0
31.5	139.5	142.0	156.0	153.5
40.0	140.0	142.5	155.0	153.0
50.0	141.0	143.5	154.0	152.5
63.0	141.5	144.5	153.0	152.0
80.0	142.0	145.0	151.5	151.5
100.0	142.5	145.5	150.0	151.0
125.0	142.5	146.0	148.5	151.0
160.0	142.5	146.5	146.5	151.5
200.0	142.5	147.0	145.0	152.0
250.0	142.0	147.5	143.0	153.0
315.0	142.0	148.0	140.5	154.0
400.0	141.5	148.0	138.0	154.0
500.0	141.0	148.0	135.5	154.0
630.0	140.5	148.0	133.0	153.0
800.0	139.5	148.0	130.0	151.5
1000.0	139.0	148.5	128.0	151.0
1250.0	138.0	148.0	126.0	149.5
1600.0	137.0	148.0	124.0	148.0
2000.0	136.5	148.0	122.0	147.0
2500.0	135.5	147.5	120.0	145.5
3150.0	134.5	147.5	118.0	144.0
4000.0	133.5	147.0	116.0	142.5
5000.0	132.5	146.5	114.0	141.0
6300.0	131.0	146.0	112.0	139.0
8000.0	130.0	146.0	110.0	138.0
10000.0	129.0	145.0	108.0	136.5
Overall SPL	154.5	161.0	168.0	166.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

Zone 9 — SRB Frustum and Nose Cone — Stations 395-200 (General Specifications)

INTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N}/\text{m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	131.0	115.0		139.5
6.3	132.0	116.0		140.0
8.0	132.0	116.0		140.5
10.0	132.5	116.0	N	140.5
12.5	132.0	116.0		140.0
16.0	131.0	115.5	O	139.0
20.0	130.0	115.0		137.0
25.0	128.5	114.0	T	134.5
31.5	126.5	113.0		132.0
40.0	125.0	114.0		130.5
50.0	122.5	110.5		127.0
63.0	123.0	111.5		126.5
80.0	123.5	112.5	A	126.0
100.0	123.5	113.5		126.5
125.0	124.0	114.5	P	126.0
160.0	123.5	115.5		126.0
200.0	123.5	116.0	P	125.0
250.0	123.5	116.5		124.5
315.0	123.0	117.0	L	124.0
400.0	122.5	117.0		122.0
500.0	122.0	117.5	I	121.0
630.0	121.5	118.0		119.5
800.0	121.0	118.0	C	118.0
1000.0	120.0	117.5		116.5
1250.0	119.5	117.5	A	115.0
1600.0	118.5	117.5		114.0
2000.0	117.5	117.5	B	112.5
2500.0	116.5	117.0		111.0
3150.0	114.5	115.5	L	108.5
4000.0	111.5	113.0		105.0
5000.0	109.0	110.5	E	101.5
6300.0	106.0	108.0		98.5
8000.0	103.0	105.5		95.5
10000.0	100.0	103.0		92.0
Overall SPL	141.5	130.5		148.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Subzone 9-1 - SRB Frustum - Stations 395-275 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	131.0	121.0	146.0	146.0
6.3	132.5	122.5	145.5	147.0
8.0	133.0	123.5	145.0	148.0
10.0	134.5	124.5	144.5	149.0
12.5	135.5	125.5	144.0	149.5
16.0	136.0	126.5	143.0	150.0
20.0	137.5	128.5	142.0	151.0
25.0	138.5	130.0	141.0	151.0
31.5	139.0	131.5	140.0	151.0
40.0	140.0	133.0	138.5	151.0
50.0	140.5	134.5	137.0	150.0
63.0	141.0	135.5	136.0	148.5
80.0	141.5	136.5	134.0	148.0
100.0	141.5	137.5	133.0	148.0
125.0	142.0	138.5	131.5	148.0
160.0	141.5	139.5	130.0	149.0
200.0	141.5	140.0	128.0	149.5
250.0	141.5	140.5	126.5	149.0
315.0	141.0	141.0	124.0	148.5
400.0	140.5	141.0	122.5	147.0
500.0	140.0	141.5	120.5	146.0
630.0	139.5	142.0	118.5	144.5
800.0	139.0	142.0	117.0	143.0
1000.0	138.0	141.5	115.5	141.5
1250.0	137.5	141.5	114.0	140.0
1600.0	136.5	141.5	112.5	139.0
2000.0	135.5	141.5	111.0	137.5
2500.0	134.5	141.0	109.5	136.5
3150.0	133.5	140.5	108.0	135.0
4000.0	132.5	140.0	106.5	133.5
5000.0	132.0	139.5	105.0	132.0
6300.0	131.0	139.0	103.5	131.0
8000.0	130.0	138.5	101.5	130.0
10000.0	129.0	138.0	100.0	128.5
Overall SPL	154.0	154.5	157.0	162.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

Subzone 9-2 - SRB Nose Cone - Stations 275-200 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	131.0	121.0	146.0	144.0
6.3	132.5	122.5	145.5	145.5
8.0	133.0	123.5	145.0	147.0
10.0	134.5	124.5	144.5	148.0
12.5	135.5	125.5	144.0	149.0
16.0	136.0	126.5	143.0	150.0
20.0	137.5	128.5	142.0	148.0
25.0	138.5	130.0	141.0	149.0
31.5	139.0	131.5	140.0	150.0
40.0	140.0	133.0	138.5	152.0
50.0	140.5	134.5	137.0	152.5
63.0	141.0	135.5	136.0	153.0
80.0	141.5	136.5	134.0	153.0
100.0	141.5	137.5	133.0	153.5
125.0	142.0	138.5	131.5	152.5
160.0	141.5	139.5	130.0	151.5
200.0	141.5	140.0	128.0	149.0
250.0	141.5	140.5	126.5	147.0
315.0	141.0	141.0	124.0	145.5
400.0	140.5	141.0	122.5	143.0
500.0	140.0	141.5	120.5	141.0
630.0	139.5	142.0	118.5	139.0
800.0	139.0	142.0	117.0	137.0
1000.0	138.0	141.5	115.5	135.5
1250.0	137.5	141.5	114.0	133.5
1600.0	136.5	141.5	112.5	131.5
2000.0	135.5	141.5	111.0	130.0
2500.0	134.5	141.0	109.5	127.5
3150.0	133.5	140.5	108.0	125.5
4000.0	132.5	140.0	106.5	124.0
5000.0	132.0	139.5	105.0	122.0
6300.0	131.0	139.0	103.5	120.0
8000.0	130.0	138.5	101.5	118.5
10000.0	129.0	138.0	100.0	116.0
Overall SPL	154.0	154.5	157.0	163.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

# SRB In-flight Oscillating Shock

## EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Forward Separation Motors</u>	<u>SRB/ET Aft Attach Struts</u>
5.0	145.5	161.5
6.3	147.0	161.0
8.0	148.0	160.0
10.0	149.0	159.0
12.5	150.0	158.0
16.0	151.0	157.5
20.0	152.0	156.5
25.0	153.0	155.0
31.5	153.5	154.0
40.0	154.0	152.5
50.0	154.0	151.0
63.0	154.5	149.5
80.0	154.5	147.5
100.0	154.0	145.5
125.0	153.5	143.5
160.0	153.0	141.5
200.0	152.0	139.5
250.0	151.0	137.5
315.0	150.0	135.5
400.0	149.0	133.0
500.0	147.5	130.5
630.0	146.0	128.0
800.0	144.5	125.5
1000.0	143.0	123.5
1250.0	141.5	121.0
1600.0	140.0	119.0
2000.0	138.5	117.0
2500.0	137.0	115.0
3150.0	135.5	113.0
4000.0	134.0	111.0
5000.0	132.5	109.0
6300.0	131.0	107.0
8000.0	129.5	105.0
10000.0	128.0	103.0
Overall APL	165.0	171.5
Duration	N/A	N/A

# SRB In-flight Fluctuating Pressure Protuberance

## EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Aft Separation Motors	Systems Tunnel	SRB/ET Aft Attach Struts	SRB/ET Forward Attach Fitting	SRB/ET Range Safety Cross Strapping Tunnel	Forward Separation Motors
5.0	150.0	144.0	149.0	145.0	144.0	132.0
6.3	151.0	145.0	150.0	146.0	145.0	133.0
8.0	152.0	146.0	151.0	147.0	146.0	134.0
10.0	153.0	147.0	152.0	148.0	147.0	135.0
12.5	154.0	148.0	153.0	149.0	148.0	136.0
16.0	154.5	149.0	154.0	150.0	149.0	137.0
20.0	155.0	150.0	154.5	151.5	150.0	138.0
25.0	156.0	151.0	144.0	153.0	151.0	139.0
31.5	157.0	152.0	155.5	154.0	152.0	140.0
40.0	157.0	152.5	156.0	155.0	152.5	141.5
50.0	157.5	153.0	156.0	155.5	153.0	142.5
63.0	157.5	154.0	156.0	156.0	154.0	153.5
80.0	157.5	155.0	156.5	156.0	155.0	144.5
100.0	157.0	155.0	156.5	156.5	155.0	145.5
125.0	157.0	155.5	156.0	156.0	155.5	147.0
160.0	156.0	156.0	155.0	156.0	156.0	148.0
200.0	155.5	156.0	155.0	156.0	156.0	148.0
250.0	155.0	156.0	154.5	156.0	156.0	150.0
315.0	154.0	155.5	154.0	155.5	155.5	151.0
400.0	153.0	155.0	153.0	155.0	155.0	152.0
500.0	152.0	155.0	152.0	154.5	155.0	153.0
630.0	151.0	154.5	151.0	153.5	154.5	154.0
800.0	150.0	153.5	150.0	153.0	153.5	155.0
1000.0	149.0	153.0	149.0	152.5	153.0	156.0
1250.0	148.0	152.5	148.0	152.0	152.5	156.5
1600.0	146.5	151.5	146.5	151.0	151.5	157.0
2000.0	145.5	151.0	145.0	150.0	151.0	157.5
2500.0	145.5	150.0	143.5	149.0	150.0	148.0
3150.0	143.0	149.0	142.0	148.0	149.0	157.5
4000.0	142.0	148.0	140.5	147.0	148.0	157.0
5000.0	141.0	147.0	138.5	146.0	147.0	156.0
6300.0	140.0	146.0	137.0	144.5	146.0	154.5
8000.0	139.0	145.0	136.0	143.0	145.0	153.0
10000.0	138.0	144.0	135.0	141.5	144.0	152.0
Overall STL	169.0	168.0	167.0	168.0	168.0	168.0

Duration: 80 sec plus 40 sec per mission

# SRB AFT SKIRT THERMAL CURTAIN, EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>Inflight Fluctuating Pressure</u>	<u>Reentry</u>
5.0	132.0	145.0	153.0
6.3	133.0	146.0	157.0
8.0	134.0	147.0	157.0
10.0	135.5	147.5	156.0
12.5	137.0	148.0	154.0
16.0	138.0	149.0	153.0
20.0	139.5	148.0	152.0
25.0	141.0	147.5	150.0
31.5	142.0	147.0	149.0
40.0	143.5	146.0	148.0
50.0	144.5	145.0	147.0
63.0	145.5	144.0	147.0
80.0	146.0	143.0	147.0
100.0	146.5	142.0	147.0
125.0	147.0	141.0	147.0
160.0	147.5	140.0	148.0
200.0	147.5	138.5	148.0
250.0	147.5	137.0	149.0
315.0	147.0	136.0	149.0
400.0	147.0	134.5	148.0
500.0	146.5	133.0	147.0
630.0	146.0	132.0	146.0
800.0	145.5	130.5	144.0
1000.0	145.0	129.0	142.0
1250.0	144.5	128.0	140.0
1600.0	144.0	126.5	138.0
2000.0	143.5	125.0	136.0
2500.0	143.0	124.0	134.0
3150.0	142.0	122.5	132.0
4000.0	141.0	121.0	130.0
5000.0	140.0	119.5	128.0
6300.0	139.0	118.0	126.0
8000.0	138.0	116.0	124.0
10000.0	137.0	115.0	122.0
Overall SPL	159.5	158.0	165.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	60 sec plus 30 sec per mission

## SECTION V. SPECIFICATIONS FOR SPECIFIC COMPONENTS

Input to the Range Safety Panels. Total Weight of Components On the Panel  
= 20 lb.

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.021  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 64 Hz @ 0.042  $g^2/Hz$   
64 - 150 Hz @ +3 dB/oct  
150 - 250 Hz @ 0.10  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.017  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0085  $g^2/Hz$

Composite = 7.1  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 150 Hz @ 0.025  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 400 Hz @ 0.050  $g^2/Hz$   
400 - 480 Hz @ -15 dB/oct  
480 - 650 Hz @ 0.019  $g^2/Hz$   
650 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.070  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.021  $g^2/Hz$

Composite = 8.9  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.036  $g^2/Hz$   
20 - 110 Hz @ +3 dB/oct  
110 - 250 Hz @ 0.20  $g^2/Hz$   
250 - 470 Hz @ -9 dB/oct  
470 - 1000 Hz @ 0.030  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0075  $g^2/Hz$

Composite = 9.4  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 360 Hz @ 0.10  $g^2/Hz$   
360 - 460 Hz @ -15 dB/oct  
460 - 630 Hz @ 0.030  $g^2/Hz$   
630 - 800 Hz @ +15 dB/oct  
800 - 1000 Hz @ 0.10  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 11.2  $g_{rms}$



Input to the Range Safety Panels. Total Weight of Components On the Panel  
= 20 lb. (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.085  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 64 Hz @ 0.17  $g^2/Hz$   
64 - 150 Hz @ +3 dB/oct  
150 - 250 Hz @ 0.40  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.070  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.034  $g^2/Hz$

Composite = 14.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 400 Hz @ 0.20  $g^2/Hz$   
400 - 480 Hz @ -15 dB/oct  
480 - 650 Hz @ 0.075  $g^2/Hz$   
650 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.28  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.05  $g^2/Hz$

Composite = 17.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.38  $g^2/Hz$   
20 - 36 Hz @ +3 dB/oct  
36 - 60 Hz @ 0.64  $g^2/Hz$   
60 - 70 Hz @ -3 dB/oct  
70 - 250 Hz @ 0.44  $g^2/Hz$   
250 - 550 Hz @ -12 dB/oct  
550 - 1000 Hz @ 0.020  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 12.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.54  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 50 Hz @ 0.90  $g^2/Hz$   
50 - 80 Hz @ -12 dB/oct  
80 - 360 Hz @ 0.15  $g^2/Hz$   
360 - 450 Hz @ -15 dB/oct  
450 - 700 Hz @ 0.050  $g^2/Hz$   
700 - 760 Hz @ +15 dB/oct  
760 - 900 Hz @ 0.075  $g^2/Hz$   
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.034  $g^2/Hz$

Composite = 12.9  $g_{rms}$

Input to the Range Safety Panels. Total Weight of Components On the Panel  
= 20 lb. (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3.750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to Components on the Range Safety Panels. Total Weight of Components on the Panel = 20 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 250 Hz @ 0.10  $g^2/Hz$   
 250 - 448 Hz @ -9 dB/oct  
 448 - 1400 Hz @ 0.017  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0085  $g^2/Hz$

Composite = 7.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 150 Hz @ 0.025  $g^2/Hz$   
 150 - 300 Hz @ +3 dB/oct  
 300 - 800 Hz @ 0.050  $g^2/Hz$   
 800 - 855 Hz @ +15 dB/oct  
 855 - 1100 Hz @ 0.070  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.021  $g^2/Hz$

Composite = 9.4  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 250 Hz @ 0.20  $g^2/Hz$   
 250 - 470 Hz @ -9 dB/oct  
 470 - 1000 Hz @ 0.030  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0075  $g^2/Hz$

Composite = 9.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 1000 Hz @ 0.10  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.025  $g^2/Hz$

Composite = 12.1  $g_{rms}$

Input to Components on the Range Safety Panels. Total Weight of Components on the Panel = 20 lb. (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.27  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 250 Hz @ 0.40  $g^2/Hz$   
 250 - 448 Hz @ -9 dB/oct  
 448 - 1400 Hz @ 0.070  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.034  $g^2/Hz$

Composite = 14.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 150 Hz @ 0.10  $g^2/Hz$   
 150 - 300 Hz @ +3 dB/oct  
 300 - 800 Hz @ 0.20  $g^2/Hz$   
 800 - 855 Hz @ +15 dB/oct  
 855 - 1100 Hz @ 0.28  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.085  $g^2/Hz$

Composite = 16.8  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

20 Hz @ 0.38  $g^2/Hz$   
 20 - 70 Hz @ +3 dB/oct  
 70 - 90 Hz @ 1.20  $g^2/Hz$   
 90 - 115 Hz @ -12 dB/oct  
 115 - 250 Hz @ 0.41  $g^2/Hz$   
 250 - 550 Hz @ -12 dB/oct  
 550 - 1000 Hz @ 0.020  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0050  $g^2/Hz$

Composite = 13.9  $g_{rms}$

20 Hz @ 0.54  $g^2/Hz$   
 20 - 34 Hz @ +3 dB/oct  
 34 - 50 Hz @ 0.90  $g^2/Hz$   
 50 - 80 Hz @ -12 dB/oct  
 80 - 450 Hz @ 0.15  $g^2/Hz$   
 450 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.034  $g^2/Hz$

Composite = 13.8  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to Components on the Range Safety Panels. Total Weight of Components  
on the Panel = 20 lb. (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

Input to the Range Safety Panels. Total Weight of Components on the Panel =  
55 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 64 Hz @ 0.030  $g^2/Hz$   
64 - 150 Hz @ +3 dB/oct  
150 - 250 Hz @ 0.070  $g^2/Hz$   
250 - 445 Hz @ -9 dB/oct  
445 - 1400 Hz @ 0.012  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0062  $g^2/Hz$

Composite = 5.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 135 Hz @ 0.020  $g^2/Hz$   
135 - 255 Hz @ +3 dB/oct  
255 - 320 Hz @ 0.037  $g^2/Hz$   
320 - 385 Hz @ -15 dB/oct  
385 - 580 Hz @ 0.015  $g^2/Hz$   
580 - 750 Hz @ +15 dB/oct  
750 - 1100 Hz @ 0.055  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.016  $g^2/Hz$

Composite = 8.0  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.031  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 250 Hz @ 0.15  $g^2/Hz$   
250 - 470 Hz @ -9 dB/oct  
470 - 1000 Hz @ 0.023  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0058  $g^2/Hz$

Composite = 8.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 340 Hz @ 0.080  $g^2/Hz$   
340 - 420 Hz @ -15 dB/oct  
420 - 560 Hz @ 0.025  $g^2/Hz$   
560 - 700 Hz @ +15 dB/oct  
700 - 1000 Hz @ 0.030  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 10.2  $g_{rms}$

Input to the Range Safety Panels. Total Weight of Components On the Panel =  
55 lb. (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.060  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 64 Hz @ 0.12  $g^2/Hz$   
64 - 150 Hz @ +3 dB/oct  
150 - 250 Hz @ 0.28  $g^2/Hz$   
250 - 445 Hz @ -9 dB/oct  
445 - 1400 Hz @ 0.050  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 135 Hz @ 0.080  $g^2/Hz$   
135 - 255 Hz @ +3 dB/oct  
255 - 320 Hz @ 0.15  $g^2/Hz$   
320 - 385 Hz @ -15 dB/oct  
385 - 580 Hz @ 0.060  $g^2/Hz$   
580 - 750 Hz @ +15 dB/oct  
750 - 1100 Hz @ 0.22  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.067  $g^2/Hz$

Composite = 16.1  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 50 Hz @ 0.50  $g^2/Hz$   
50 56 Hz @ -9 dB/oct  
56 - 230 Hz @ 0.36  $g^2/Hz$   
230 - 500 Hz @ -12 dB/oct  
500 - 1000 Hz @ 0.017  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0042  $g^2/Hz$

Composite = 11.0  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.75  $g^2/Hz$   
40 - 60 Hz @ -12 dB/oct  
60 - 320 Hz @ 0.13  $g^2/Hz$   
320 - 400 Hz @ -15 dB/oct  
400 - 600 Hz @ 0.040  $g^2/Hz$   
600 - 650 Hz @ +15 dB/oct  
650 - 800 Hz @ 0.065  $g^2/Hz$   
800 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.026  $g^2/Hz$

Composite = 11.4  $g_{rms}$

Input to the Range Safety Panels. Total Weight of Component on the Panel =  
55 lb. (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3,750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only



Input to Components on the Range Safety Panels. Total Weight of Components  
on the Panel = 55 lb.

1. Acceptance Test Criteria (1 min/axis)

20 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.007 \text{ g}^2/\text{Hz}$

Composite = 6.1 grms

Qualification/Acceptance Test Criteria (5 min/axis)

20 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.02 \text{ g}^2/\text{Hz}$

Composite = 10.3 grms

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 250 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
250 - 470 Hz @ -9 dB/oct  
470 - 1000 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0058 \text{ g}^2/\text{Hz}$

Composite =  $8.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

Input to Components on the Range Safety Panels. Total Weight of Components on the Panel = 55 lb. (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.19  $g^2/Hz$   
 20 - 30 Hz @ +3 dB/oct  
 30 - 250 Hz @ 0.28  $g^2/Hz$   
 250 - 445 Hz @ -9 dB/oct  
 445 - 1400 Hz @ 0.050  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.025  $g^2/Hz$

Composite = 12.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.040  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 135 Hz @ 0.080  $g^2/Hz$   
 135 - 255 Hz @ +3 dB/oct  
 255 - 700 Hz @ 0.15  $g^2/Hz$   
 700 - 755 Hz @ +15 dB/oct  
 755 - 1100 Hz @ 0.22  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.067  $g^2/Hz$

Composite = 16.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.50  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 60 Hz @ 1.00  $g^2/Hz$   
 60 - 75 Hz @ -12 dB/oct  
 75 - 230 Hz @ 0.36  $g^2/Hz$   
 230 - 500 Hz @ -12 dB/oct  
 500 - 1000 Hz @ 0.017  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0042  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.75  $g^2/Hz$   
 40 - 60 Hz @ -12 dB/oct  
 60 - 400 Hz @ 0.13  $g^2/Hz$   
 400 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.026  $g^2/Hz$

Composite = 12.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
 5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
 5 - 10 Hz @ 0.6 G's peak  
 10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to Components on the Range Safety Panels. Total Weight of Components  
on the Panel = 55 lb. (Cont.)

## 6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

### A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1.875 G's peak

### B. Water Landing

#### Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

#### Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

### C. Parachute Deployment

#### Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

#### Lateral Axes

Half Sine Pulse  
G's peak Amplitude  
300 msec Duration

Input to the Range Safety System Linear Shaped Charge (LSC)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.00025  $g^2/Hz$   
20 - 150 Hz @ +6 dB/oct  
150 - 300 Hz @ 0.015  $g^2/Hz$   
300 - 2000 Hz @ -6.5 dB/oct  
2000 Hz @ 0.00025  $g^2/Hz$

Composite = 2.6 grms

Long Axis

20 - 60 Hz @ 0.0025  $g^2/Hz$   
60 - 260 Hz @ +4.5 dB/oct  
260 - 440 Hz @ 0.025  $g^2/Hz$   
440 - 2000 Hz @ -7.0 dB/oct  
2000 Hz @ 0.000075  $g^2/Hz$

Composite = 3.9 grms

Tang. Axis

20 Hz @ 0.00023  $g^2/Hz$   
20 - 100 Hz @ +8 dB/oct  
100 - 220 Hz @ 0.015  $g^2/Hz$   
220 - 580 Hz @ -7.5 dB/oct  
580 - 2000 Hz @ 0.0014  $g^2/Hz$

Composite = 2.5 grms

2. Flight Random Vibration Criteria (4 minutes plus 2 min/mission/axis)

Radial Axis

20 - 60 Hz @ 0.013  $g^2/Hz$   
60 - 100 Hz @ +4 dB/oct  
100 - 700 Hz @ 0.026  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 5.0 grms

Long. Axis

20 - 60 Hz @ 0.01  $g^2/Hz$   
60 - 260 Hz @ +4.5 dB/oct  
260 - 440 Hz @ 0.1  $g^2/Hz$   
440 - 2000 Hz @ -7.0 dB/oct  
2000 Hz @ 0.0003  $g^2/Hz$

Composite = 7.8 grms

Tang. Axis

20 Hz @ 0.0027  $g^2/Hz$   
20 - 120 Hz @ +4.5 dB/oct  
120 - 200 Hz @ 0.043  $g^2/Hz$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0043  $g^2/Hz$

Composite = 5.0 grms

Input to the Range Safety System Linear Shaped Charge (LSC) (Cont.)

3. Reentry Random Vibration Criteria (60 seconds plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.001  $g^2/Hz$   
20 - 150 Hz @ +6 dB/oct  
150 - 300 Hz @ 0.06  $g^2/Hz$   
300 - 2000 Hz @ -6.5 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 5.1 grms

Long. Axis

20 Hz @ 0.007  $g^2/Hz$   
20 - 100 Hz @ +4.5 dB/oct  
100 - 400 Hz @ 0.07  $g^2/Hz$   
400 - 700 Hz @ -11.5 dB/oct  
700 - 1500 Hz @ 0.008  $g^2/Hz$   
1500 - 2000 Hz @ -17.5 dB/oct  
2000 Hz @ 0.0015  $g^2/Hz$

Composite = 6.3 grms

Tang. Axis

20 Hz @ 0.00091  $g^2/Hz$   
20 - 100 Hz @ +8 dB/oct  
100 - 220 Hz @ 0.06  $g^2/Hz$   
220 - 580 Hz @ -7.5 dB/oct  
580 - 2000 Hz @ 0.0056  $g^2/Hz$

Composite = 5.0 grms

4. Vehicle Dynamics Criteria

Long. Axis

3.5 - 5 Hz @ 1.0 G's Peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the Range Safety System Linear Shaped Charge (LSC) (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

No Shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
8 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
1.7 G's peak Amplitude  
300 msec Duration

Input to the Linear Shaped Charge (LSC) Assembly and the Detonator Block  
 Located at the forward Skirt/Frustum Separation Plane

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
 20 - 500 Hz @ +3 dB/oct  
 500 - 700 Hz @ 0.32  $g^2/Hz$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.014  $g^2/Hz$

Composite = 15.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 150 Hz @ +3 dB/oct  
 150 - 1000 Hz @ 0.12  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.015  $g^2/Hz$

Composite = 12.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0054  $g^2/Hz$   
 20 - 150 Hz @ +3 dB/oct  
 150 - 320 Hz @ 0.040  $g^2/Hz$   
 320 - 400 Hz @ +6 dB/oct  
 400 - 800 Hz @ 0.065  $g^2/Hz$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0042  $g^2/Hz$

Composite = 7.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
 20 - 100 Hz @ +3 dB/oct  
 100 - 150 Hz @ 0.050  $g^2/Hz$   
 150 - 190 Hz @ -6 dB/oct  
 190 - 1000 Hz @ 0.030  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0075  $g^2/Hz$

Composite = 6.8  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 600 Hz @ +3 dB/oct  
 600 - 1000 Hz @ 0.44  $g^2/Hz$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.055  $g^2/Hz$

Composite = 21.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.028  $g^2/Hz$   
 20 - 80 Hz @ +3 dB/oct  
 80 - 360 Hz @ 0.11  $g^2/Hz$   
 360 - 720 Hz @ +3 dB/oct  
 720 - 1300 Hz @ 0.22  $g^2/Hz$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.060  $g^2/Hz$

Composite = 17.5  $g_{rms}$

C-3

Input to the Linear Shaped Charge (LSC) Assembly and the Detonator Block  
Located at the Forward Skirt/Frustum Separation Plane (Cont.)

4. Reentry Random Vibration Criteria (90 sec/axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
20 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 1.30  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.056  $g^2/Hz$

Composite = 31.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.064  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 1000 Hz @ 0.48  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.060  $g^2/Hz$

Composite = 25.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only



Input to the Linear Shaped Charge (LSC) Assembly and the Detonator Block  
Located at the Forward Skirt/Frustum Separation Plane (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

SRB/ET Separation

	50 Hz @ 24 G's peak
50 -	100 Hz @ +12 dB/oct
	100 Hz @ 94 G's peak
100 -	4,000 Hz @ +6 dB/oct
4,000 -	10,000 Hz @ 3,750 G's peak

Input to the Confined Detonating Fuse (CDF) Initiators, CDF Assembly and CDF Manifold

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 30 Hz @ 0.20  $g^2/Hz$   
30 - 50 Hz @ +3 dB/oct  
50 - 200 Hz @ 0.33  $g^2/Hz$   
200 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.85  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 25.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.20  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 0.40  $g^2/Hz$   
60 - 65 Hz @ -12 dB/oct  
65 - 1000 Hz @ 0.30  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 20.2  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 34 Hz @ +6 dB/oct  
34 - 83 Hz @ 0.15  $g^2/Hz$   
83 - 200 Hz @ +3 dB/oct  
200 - 400 Hz @ 0.36  $g^2/Hz$   
400 - 500 Hz @ -9 dB/oct  
500 - 800 Hz @ 0.18  $g^2/Hz$   
800 - 1225 Hz @ -9 dB/oct  
1225 - 1500 Hz @ 0.050  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 16.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.056  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 340 Hz @ 0.14  $g^2/Hz$   
340 - 400 Hz @ +6 dB/oct  
400 - 1200 Hz @ 0.19  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.11  $g^2/Hz$

Composite = 17.9  $g_{rms}$

Input to the Confined Detonating Fuse (CDF) Initiators, CDF Assembly and CDF Manifold (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis	Long. and Tang. Axes
20 - 45 Hz @ 0.18 g <sup>2</sup> /Hz	20 Hz @ 0.070 g <sup>2</sup> /Hz
45 - 80 Hz @ +3 dB/oct	20 - 80 Hz @ +3 dB/oct
80 - 115 Hz @ 0.32 g <sup>2</sup> /Hz	80 - 305 Hz @ 0.28 g <sup>2</sup> /Hz
115 - 305 Hz @ +3 dB/oct	305 - 570 Hz @ +3 dB/oct
305 - 460 Hz @ 0.85 g <sup>2</sup> /Hz	570 - 700 Hz @ 0.52 g <sup>2</sup> /Hz
460 - 540 Hz @ +3 dB/oct	700 - 810 Hz @ +3 dB/oct
540 - 1050 Hz @ 1.00 g <sup>2</sup> /Hz	810 - 1250 Hz @ 0.60 g <sup>2</sup> /Hz
1050 - 2000 Hz @ -9 dB/oct	1250 - 2000 Hz @ -9 dB/oct
2000 Hz @ 0.15 g <sup>2</sup> /Hz	2000 Hz @ 0.15 g <sup>2</sup> /Hz
Composite = 35.1 g <sub>rms</sub>	Composite = 28.3 g <sub>rms</sub>

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis	Long. and Tang. Axes
20 - 30 Hz @ 0.80 g <sup>2</sup> /Hz	20 Hz @ 0.80 g <sup>2</sup> /Hz
30 - 50 Hz @ +3 dB/oct	20 - 40 Hz @ +3 dB/oct
50 - 200 Hz @ 1.30 g <sup>2</sup> /Hz	40 - 60 Hz @ 1.60 g <sup>2</sup> /Hz
200 - 500 Hz @ +3 dB/oct	60 - 65 Hz @ -12 dB/oct
500 - 700 Hz @ 3.40 g <sup>2</sup> /Hz	65 - 1000 Hz @ 1.20 g <sup>2</sup> /Hz
700 - 2000 Hz @ -9 dB/oct	1000 - 2000 Hz @ -9 dB/oct
2000 Hz @ 0.15 g <sup>2</sup> /Hz	2000 Hz @ 0.15 g <sup>2</sup> /Hz
Composite = 51.5 g <sub>rms</sub>	Composite = 40.5 g <sub>rms</sub>

5. Vehicle Dynamics Criteria

Longitudinal Axis	Lateral Axes
3.5 - 5 Hz @ 1.0 G's peak*	2 - 5 Hz @ 4.3 G's peak*
5 - 40 Hz @ 1.0 G's peak	5 - 10 Hz @ 0.6 G's peak
	10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

Input to the Confined Detonating Fuse (CDF) Initiators, CDF Assembly and  
CDF Manifold (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

50 Hz @ 47 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 188 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 7,500 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

## Input to the NSI Detonator

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.095  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @ 0.30  $g^2/Hz$   
90 - 97 Hz @ -12 dB/oct  
97 - 130 Hz @ 0.22  $g^2/Hz$   
130 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.85  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 25.6  $g_{rms}$

#### Long. and Tang. Axes

20 - 145 Hz @ 0.14  $g^2/Hz$   
145 - 180 Hz @ +9 dB/oct  
180 - 540 Hz @ 0.25  $g^2/Hz$   
540 - 810 Hz @ +3 dB/oct  
810 - 1200 Hz @ 0.37  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.13  $g^2/Hz$

Composite = 22.9  $g_{rms}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 145 Hz @ 0.54  $g^2/Hz$   
145 - 180 Hz @ +9 dB/oct  
180 - 540 Hz @ 1.00  $g^2/Hz$   
540 - 810 Hz @ +3 dB/oct  
810 - 1200 Hz @ 1.50  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.54  $g^2/Hz$

Composite = 45.8  $g_{rms}$

Input to the NSI Detonator (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.38  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @ 1.20  $g^2/Hz$   
90 - 97 Hz @ -12 dB/oct  
97 - 130 Hz @ 0.90  $g^2/Hz$   
130 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 3.40  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 51.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.54  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 50 Hz @ 0.90  $g^2/Hz$   
50 - 54 Hz @ -12 dB/oct  
54 - 70 Hz @ 0.70  $g^2/Hz$   
70 - 120 Hz @ +3 dB/oct  
120 - 1000 Hz @ 1.20  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 40.0  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

Input to the NSI Detonator (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
1000 Hz @ 94 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3,750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

## Input to the Nose Cap Separation Thrusters and Pressure Cartridges

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axes

20 - 50 Hz @  $0.32 \text{ g}^2/\text{Hz}$   
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00018 \text{ g}^2/\text{Hz}$

Composite =  $3.6 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 150 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
150 - 240 Hz @ -9 dB/oct  
240 - 1000 Hz @  $0.0032 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0004 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

### 2. Lift-off Random Vibration Criteria (1 min/axis)

#### Radial Axis

20 - 800 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00064 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 1100 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0019 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 - 120 Hz @  $0.0080 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00068 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 120 Hz @  $0.0056 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0018 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$



Input to the Nose Cap Separation Thrusters and Pressure Cartridges (Cont.)

4. Reentry Random Vibration Criteria (90 sec/axis)

Radial Axis

20 - 50 Hz @ 0.13  $g^2/Hz$   
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @ 0.090  $g^2/Hz$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00073  $g^2/Hz$

Composite = 7.3  $g_{rms}$

Long. and Tang. Axes

20 - 150 Hz @ 0.022  $g^2/Hz$   
150 - 240 Hz @ -9 dB/oct  
240 - 1000 Hz @ 0.013  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0017  $g^2/Hz$

Composite = 5.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria (2 shocks/axis)

No shock test required.

\* Design Criteria Only

### Input to Forward Separation Motors

#### 1. Acceptance Test Criteria (1 min/axis)

##### Radial Axis

20 - 40 Hz @ 0.032  $g^2/Hz$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @ 0.021  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00058  $g^2/Hz$

Composite = 4.3 grms

##### Long. and Tang. Axes

20 - 800 Hz @ 0.0082  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00052  $g^2/Hz$

Composite = 3.0 grms

#### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.017  $g^2/Hz$   
20 - 28 Hz @ +3 dB/oct  
28 - 800 Hz @ 0.023  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00069  $g^2/Hz$

Composite = 5.0 grms

##### Long. and Tang. Axes

20 Hz @ 0.011  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 900 Hz @ 0.022  $g^2/Hz$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00090  $g^2/Hz$

Composite = 5.0 grms

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 27 Hz @ +3 dB/oct  
27 - 120 Hz @ 0.017  $g^2/Hz$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @ 0.060  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0016  $g^2/Hz$

Composite = 7.5 grms

##### Long. and Tang. Axes

20 Hz @ 0.0028  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @ 0.0051  $g^2/Hz$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @ 0.020  $g^2/Hz$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0023  $g^2/Hz$

Composite = 5.0 grms

#### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 - 40 Hz @ 0.13  $g^2/Hz$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @ 0.085  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0023  $g^2/Hz$

Composite = 8.6 grms

##### Long. and Tang. Axes

20 - 800 Hz @ 0.033  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0021  $g^2/Hz$

Composite = 6.1 grms

## Input to the SRB Forward Separation Motors (Cont.)

### 5. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

#### Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

### 6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Ordnance

No shock test required.

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
40 g's peak amplitude  
50 msec duration

##### Lateral Axes

Half Sine Pulse  
15 g's peak amplitude  
100 msec duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
1.0 g's peak amplitude  
300 msec duration

##### Lateral Axes

Half Sine Pulse  
5.7 g's peak amplitude  
300 msec duration

\* Design criteria only

# Input to the Forward Separation Motors (Cont.)

## 7. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20 N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>Inflight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	131.0	132.0	145.5	146.0
6.3	132.5	133.0	147.0	147.0
8.0	133.0	134.0	148.0	148.0
10.0	134.5	135.0	149.0	149.0
12.5	135.5	136.0	150.0	149.5
16.0	136.0	137.0	151.0	150.0
20.0	137.5	138.0	152.0	151.0
25.0	138.5	139.0	153.0	151.0
31.5	139.0	140.0	153.5	151.0
40.0	140.0	141.5	154.0	151.0
50.0	140.5	142.5	154.0	150.0
63.0	141.0	143.5	154.5	148.5
80.0	141.5	144.5	154.5	148.0
100.0	141.5	145.5	154.0	148.0
125.0	142.0	147.0	153.5	148.0
160.0	141.5	148.0	153.0	149.0
200.0	141.5	148.0	152.0	149.5
250.0	141.5	150.0	151.0	149.0
315.0	141.0	151.0	150.0	148.5
400.0	140.5	152.0	149.0	147.0
500.0	140.0	153.0	147.5	146.0
630.0	139.5	154.0	146.0	144.5
800.0	139.0	155.0	144.5	143.0
1000.0	138.0	156.0	143.0	141.5
1250.0	137.5	156.5	141.5	140.0
1600.0	136.5	157.0	140.0	139.0
2000.0	135.5	157.5	138.5	137.5
2500.0	134.5	158.0	137.0	136.5
3150.0	133.5	157.5	135.5	135.0
4000.0	132.5	157.0	134.0	133.5
5000.0	132.0	156.0	132.5	132.0
6300.0	131.0	154.0	131.0	131.0
8000.0	130.0	153.0	129.5	130.0
10000.0	129.0	152.0	128.0	128.5
Overall SPL	154.0	168.0	165.0	162.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission	N/A	60 sec plus 30 sec per mission

## Input to Aft Separation Motors

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 - 200 Hz @ 0.13 g<sup>2</sup>/Hz  
200 - 350 Hz @ -12 dB/oct  
350 - 1000 Hz @ 0.015 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038 g<sup>2</sup>/Hz

Composite = 7.0 grms

#### Long. and Tang. Axes

20 - 800 Hz @ 0.06 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.018 g<sup>2</sup>/Hz

Composite = 9.2 grms

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.010 g<sup>2</sup>/Hz  
20 - 55 Hz @ +6 dB/oct  
55 - 200 Hz @ 0.077 g<sup>2</sup>/Hz  
200 - 280 Hz @ -12 dB/oct  
280 - 1200 Hz @ 0.018 g<sup>2</sup>/Hz  
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.010 g<sup>2</sup>/Hz

Composite = 6.6 grms

#### Long. and Tang. Axes

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 75 Hz @ +3 dB/oct  
75 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 10.0 grms

### 3. Boost Random Vibration Criteria (80 sec plus 04 sec/mission in each axis)

#### Radial Axis

20 - 200 Hz @ 0.54 g<sup>2</sup>/Hz  
200 - 350 Hz @ -12 dB/oct  
350 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 14.0 grms

#### Long. and Tang. Axes

20 - 800 Hz @ 0.24 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.071 g<sup>2</sup>/Hz

Composite = 18.4 grms

### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

#### Radial Axis

20 - 35 Hz @ 2.0 g<sup>2</sup>/Hz  
35 - 50 Hz @ -13 dB/oct  
50 - 200 Hz @ 0.45 g<sup>2</sup>/Hz  
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.06 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0095 g<sup>2</sup>/Hz

Composite = 14.0 grms

#### Long. and Tang. Axes

20 - 30 Hz @ 0.75 g<sup>2</sup>/Hz  
30 - 55 Hz @ -9.5 dB/oct  
55 Hz @ 0.11 g<sup>2</sup>/Hz  
55 - 82 Hz @ +6 dB/oct  
82 - 800 Hz @ 0.24 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.039 g<sup>2</sup>/Hz

Composite = 17.6 grms

## Input to Aft Separation Motors (Cont.)

### 5. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 0.7 g's peak\*  
5 - 10 Hz @ 0.7 g's peak  
10 - 40 Hz @ 1.0 g's peak

#### Lateral Axes

2 - 5 Hz @ 2.0 g's peak\*  
5 - 10 Hz @ 0.5 g's peak  
10 - 40 Hz @ 3.7 g's peak

### 6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Ordnance

50 Hz @ 24 g's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 g's peak  
100 - 4000 Hz @ +6 dB/oct  
4000 - 10000 Hz @ 3750 g's peak

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
20 g's peak  
150 msec duration

##### Lateral Axes

Half Sine Pulse  
20 g's peak amplitude  
100 msec duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
3.6 g's peak amplitude  
300 msec duration

##### Lateral Axes

Half Sine Pulse  
3.4 g's peak amplitude  
300 msec duration

\* Design criteria only

# Input to Aft Separation Motors (Cont.)

## 7. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20 N/m<sup>2</sup>)

Geometric Mean Frequency (Hz)	Lift-off	Inflight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	132.0	150.0		140.5
6.3	133.0	151.0		142.0
8.0	134.0	152.0		143.0
10.0	135.5	153.0	N	144.0
12.5	137.0	154.0		145.0
16.0	138.0	154.5	O	146.0
20.0	139.5	155.0		147.0
25.0	141.0	156.0	T	148.5
31.5	142.0	157.0		149.5
40.0	143.5	157.0		150.5
50.0	144.5	157.5		151.5
63.0	145.5	157.5	A	153.0
80.0	146.0	157.5		154.0
100.0	146.5	157.0	P	155.0
125.0	147.0	157.0		155.0
160.0	147.5	156.0	P	155.0
200.0	147.5	155.5		155.0
250.0	147.5	155.0	L	155.0
315.0	147.0	154.0		154.0
400.0	147.0	153.0	I	153.0
500.0	146.5	152.0		152.5
630.0	146.0	151.0	C	151.5
800.0	145.5	150.0		150.5
1000.0	145.0	149.0	A	149.5
1250.0	144.5	148.0		148.5
1600.0	144.0	146.5	B	147.0
2000.0	143.5	145.5		145.0
2500.0	143.0	145.5	L	144.0
3150.0	142.0	143.0		143.5
4000.0	141.0	142.0	E	142.0
5000.0	140.0	141.0		140.0
6300.0	139.0	140.0		139.0
8000.0	138.0	139.0		137.5
10000.0	137.0	138.0		136.0
Overall SPL	159.5	169.0		166.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Input to the SRB/ET Aft Attach Point Separation Bolt

1. Acceptance Test Criteria (1 min/axis)

Radial and Tang. Axes

20 - 50 Hz @ 0.0050  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.015  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0095  $g^2/Hz$

Composite = 3.4  $g_{rms}$

Longitudinal Axis

20 - 95 Hz @ 0.021  $g^2/Hz$   
95 - 140 Hz @ +9 dB/oct  
140 - 1400 Hz @ 0.070  $g^2/Hz$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.024  $g^2/Hz$

Composite = 10.8  $g_{rms}$

2. Flight Random Vibration Criteria (6 min/axis)

Radial and Tang. Axes (6 min/axis)

20 - 50 Hz @ 0.020  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

Longitudinal Axis (6 min/axis)

20 - 95 Hz @ 0.084  $g^2/Hz$   
95 - 142 Hz @ +9 dB/oct  
142 - 1400 Hz @ 0.28  $g^2/Hz$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.096  $g^2/Hz$

Composite = 21.6  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

N/A

4. Vehicle Dynamics Criteria

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 1.0 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria (2 shocks/axis)

No shock test required.

\* Design Criteria Only



## Input to the SRB/ET Forward Attach Point Separation Bolt

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.020  $g^2/Hz$   
20 - 32 Hz @ +3 dB/oct  
32 - 46 Hz @ 0.032  $g^2/Hz$   
46 - 125 Hz @ +3 dB/oct  
125 - 500 Hz @ 0.087  $g^2/Hz$   
500 - 840 Hz @ -9 dB/oct  
840 - 2000 Hz @ 0.018  $g^2/Hz$

Composite = 8.6  $g_{rms}$

#### Long. and Tang. Axes

20 - 75 Hz @ 0.017  $g^2/Hz$   
75 - 230 Hz @ +3 dB/oct  
230 - 2000 Hz @ 0.052  $g^2/Hz$

Composite = 9.9  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.036  $g^2/Hz$   
20 - 85 Hz @ +3 dB/oct  
85 - 400 Hz @ 0.15  $g^2/Hz$   
400 - 775 Hz @ -9 dB/oct  
775 - 1500 Hz @ 0.022  $g^2/Hz$   
1500 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.016  $g^2/Hz$

Composite = 10.1  $g_{rms}$

#### Long. and Tang. Axes

20 - 220 Hz @ 0.058  $g^2/Hz$   
220 - 270 Hz @ +6 dB/oct  
270 - 1200 Hz @ 0.088  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.053  $g^2/Hz$

Composite = 12.3  $g_{rms}$

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 Hz @ 0.080  $g^2/Hz$   
20 - 32 Hz @ +3 dB/oct  
32 - 46 Hz @ +3  $g^2/Hz$   
46 - 125 Hz @ +3 dB/oct  
125 - 500 Hz @ 0.35  $g^2/Hz$   
500 - 840 Hz @ -9 dB/oct  
840 - 2000 Hz @ 0.074  $g^2/Hz$

Composite = 17.2  $g_{rms}$

#### Long. and Tang. Axes

20 - 75 Hz @ 0.070  $g^2/Hz$   
75 - 225 Hz @ +3 dB/oct  
225 - 2000 Hz @ 0.21  $g^2/Hz$

Composite = 19.9  $g_{rms}$

### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

N/A

Input to the SRB/ET Forward Attach Point Separation Bolt (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

No shock test required.

\* Design Criteria Only

## Input to the Separation Bolt Pressure Cartridges (NSI Pressure Cartridge)

### 1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.020  $g^2/Hz$   
20 - 32 Hz @ +3 dB/oct  
32 - 46 Hz @ 0.32  $g^2/Hz$   
46 - 125 Hz @ +3 dB/oct  
125 - 500 Hz @ 0.087  $g^2/Hz$   
500 - 540 Hz @ -9 dB/oct  
540 - 1400 Hz @ 0.070  $g^2/Hz$   
1400 - 1540 Hz @ -9 dB/oct  
1540 - 2000 Hz @ 0.050  $g^2/Hz$

Composite = 11.6  $g_{rms}$

### 2. Flight Random Vibration Criteria (6 min/axis)

20 Hz @ 0.080  $g^2/Hz$   
20 - 32 Hz @ +3 dB/oct  
32 - 46 Hz @ 0.13  $g^2/Hz$   
46 - 125 Hz @ +3 dB/oct  
125 - 500 Hz @ 0.35  $g^2/Hz$   
500 - 540 Hz @ -9 dB/oct  
540 - 1400 Hz @ 0.28  $g^2/Hz$   
1400 - 1540 Hz @ -9 dB/oct  
1540 - 2000 Hz @ 0.21  $g^2/Hz$

Composite = 23.2  $g_{rms}$

### 3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

N/A

### 4. Vehicle Dynamics Criteria

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 1.0 G's peak  
10 - 40 Hz @ 1.7 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

No shock test required.

\* Design Criteria Only

## Input to the SRB Holddown Frangible Nut and Bolt

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.00027  $g^2/Hz$   
20 - 90 Hz @ +6 dB/oct  
90 - 150 Hz @ 0.0048  $g^2/Hz$   
150 - 165 Hz @ -9 dB/oct  
165 - 1000 Hz @ 0.0035  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0018  $g^2/Hz$

Composite = 2.5  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.000020  $g^2/Hz$   
20 - 600 Hz @ +5 dB/oct  
600 - 1000 Hz @ 0.0062  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0016  $g^2/Hz$

Composite = 2.6  $g_{rms}$

### 2. Random Vibration Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0094  $g^2/Hz$   
20 - 90 Hz @ +6 dB/oct  
90 - 150 Hz @ 0.019  $g^2/Hz$   
150 - 135 Hz @ -9 dB/oct  
165 - 1000 Hz @ 0.014  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0070  $g^2/Hz$

Composite = 5.0  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.000080  $g^2/Hz$   
20 - 600 Hz @ +5 dB/oct  
600 - 1000 Hz @ 0.025  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0063  $g^2/Hz$

Composite = 5.3  $g_{rms}$

### 3. Vehicle Dynamics Criteria

N/A

### 4. Shock Test Criteria (2 shocks/axis)

N/A

Input to the SRB Main Parachute at the Upper Ring (Station No. 318)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 60 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
60 - 73 Hz @ -6 dB/oct  
73 - 400 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00015 \text{ g}^2/\text{Hz}$

Composite =  $3.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 600 Hz @  $0.070 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00020 \text{ g}^2/\text{Hz}$

Composite =  $2.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
20 - 28 Hz @ +3 dB/oct  
28 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 120 Hz @  $0.0083 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @  $0.0056 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0023 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Input to the SRB Main Parachute at the Upper Ring (Station No. 318) (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 60 Hz @ 0.11  $g^2/Hz$   
60 - 73 Hz @ -6 dB/oct  
73 - 400 Hz @ 0.075  $g^2/Hz$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00060  $g^2/Hz$

Composite = 6.7  $g_{rms}$

Long. and Tang. Axes

20 - 600 Hz @ 0.029  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00080  $g^2/Hz$

Composite = 5.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

Input to the SRB Main Parachute at the Upper Ring (Station No. 318) (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

Lateral Axes

Half Sine Pulse  
15 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
1.0 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
5.7 G's peak Amplitude  
300 msec Duration

Input to the SRB Main Parachute at the Lower Ring (Station No. 367)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 40 Hz @ 0.016  $g^2/Hz$   
40 - 48 Hz @ -6 dB/oct  
48 - 400 Hz @ 0.011  $g^2/Hz$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.000082  $g^2/Hz$

Composite = 2.5  $g_{rms}$

Long. and Tang. Axes

20 - 600 Hz @ 0.0072  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00020  $g^2/Hz$

Composite = 2.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.017  $g^2/Hz$   
20 - 28 Hz @ +3 dB/oct  
28 - 800 Hz @ 0.023  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00069  $g^2/Hz$

Composite = 5.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.011  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 900 Hz @ 0.022  $g^2/Hz$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00090  $g^2/Hz$

Composite = 5.0  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 120 Hz @ 0.0083  $g^2/Hz$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @ 0.027  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00069  $g^2/Hz$

Composite = 5.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0028  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @ 0.0051  $g^2/Hz$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @ 0.020  $g^2/Hz$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0023  $g^2/Hz$

Composite = 5.0  $g_{rms}$



Input to the SRB Main Parachute at the Lower Ring (Station No. 367) (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 40 Hz @  $0.063 \text{ g}^2/\text{Hz}$   
40 - 48 Hz @ -6 dB/oct  
48 - 400 Hz @  $0.043 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00033 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 600 Hz @  $0.029 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00080 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

Input to the SRB Main Parachute at the Lower Ring (Station No. 367) (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3,750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

Lateral Axes

Half Sine Pulse  
15 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
1.0 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
5.7 G's peak Amplitude  
300 msec Duration

Input to the SRB Drogue Parachute at the Lower Ring (Station No. 275)

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 50 Hz @ 0.032  $g^2$ /Hz  
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @ 0.022  $g^2$ /Hz  
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00018  $g^2$ /Hz

Composite = 3.6  $g_{rms}$

Long. and Tang. Axes

20 - 150 Hz @ 0.014  $g^2$ /Hz  
150 - 240 Hz @ -9 dB/oct  
240 - 1000 Hz @ 0.0032  $g^2$ /Hz  
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.00042  $g^2$ /Hz

Composite = 2.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 - 800 Hz @ 0.024  $g^2$ /Hz  
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00064  $g^2$ /Hz

Composite = 5.0  $g_{rms}$

Long. and Tang. Axes

20 - 1100 Hz @ 0.018  $g^2$ /Hz  
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0019  $g^2$ /Hz

Composite = 5.0  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 120 Hz @ 0.0080  $g^2$ /Hz  
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @ 0.027  $g^2$ /Hz  
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00068  $g^2$ /Hz

Composite = 5.0  $g_{rms}$

Long. and Tang. Axes

20 - 120 Hz @ 0.0056  $g^2$ /Hz  
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @ 0.019  $g^2$ /Hz  
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0018  $g^2$ /Hz

Composite = 5.0  $g_{rms}$

Input to the SRB Drogue Parachute at the Lower Ring (Station No. 275) (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 50 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00073 \text{ g}^2/\text{Hz}$

Composite =  $7.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 150 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
150 - 240 Hz @ -9 dB/oct  
240 - 1000 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0017 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria

No shock test required.

\* Design Criteria Only

## Input to the Main Chute Release Separation Nut

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.32  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.014  $g^2/Hz$

Composite = 15.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 1000 Hz @ 0.12  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 12.5  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0054  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 320 Hz @ 0.040  $g^2/Hz$   
320 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.065  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0042  $g^2/Hz$

Composite = 7.9  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.010  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.050  $g^2/Hz$   
150 - 190 Hz @ -6 dB/oct  
190 - 1000 Hz @ 0.030  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0075  $g^2/Hz$

Composite = 6.8  $g_{rms}$

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 Hz @ 0.014  $g^2/Hz$   
20 - 540 Hz @ +3 dB/oct  
540 - 1050 Hz @ 0.37  $g^2/Hz$   
1050 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.056  $g^2/Hz$

Composite = 20.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.026  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 370 Hz @ 0.10  $g^2/Hz$   
370 - 800 Hz @ +3 dB/oct  
800 - 1250 Hz @ 0.22  $g^2/Hz$   
1250 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.056  $g^2/Hz$

Composite = 17.0  $g_{rms}$

Input to the Main Chute Release Separation Nut (Cont.)

4. Reentry Random Vibration Criteria (90 sec/axis)

Radial Axis

20 Hz @ 0.053  $g^2/Hz$   
20 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 1.30  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.056  $g^2/Hz$

Composite = 31.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.064  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 1000 Hz @ 0.48  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.060  $g^2/Hz$

Composite = 25.0  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.5 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the Main Cnute Release Separation Nut (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 94 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 375 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 15,000 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

Input to the Integrated Electronics Assembly (IEA) Located on the Forward Skirt Reaction Ring

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.01  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.04  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.007  $g^2/Hz$

Composite = 6.1  $g_{rms}$

Qualification/Acceptance Test Criteria (5 min/axis)

20 Hz @ 0.028  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.11  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.02  $g^2/Hz$

Composite = 10.3  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 180 Hz @ 0.018  $g^2/Hz$   
180 - 230 Hz @ +6 dB/oct  
230 - 800 Hz @ 0.030  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0020  $g^2/Hz$

Composite = 5.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 150 Hz @ 0.020  $g^2/Hz$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @ 0.013  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0033  $g^2/Hz$

Composite = 5.0  $g_{rms}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 130 Hz @ +3 dB/oct  
130 - 580 Hz @ 0.065  $g^2/Hz$   
580 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 7.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 33 Hz @ +3 dB/oct  
33 - 930 Hz @ 0.026  $g^2/Hz$   
930 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 6.1  $g_{rms}$



Input to the Integrated Electronics Assembly (IEA) Located on the Forward Skirt Reaction Ring (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 200 Hz @ 0.075  $g^2/Hz$   
200 - 245 Hz @ -6 dB/oct  
245 - 600 Hz @ 0.050  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0014  $g^2/Hz$

Composite = 6.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 150 Hz @ 0.090  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.017  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0028  $g^2/Hz$

Composite = 5.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the Integrated Electronics Assembly (IEA) Located on the Forward Skirt Reaction Ring (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

Input to the Integrated Electronics Assembly (IEA) Located on the Forward Skirt Reaction Ring (Cont.)

7. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-Flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	106.0	112.0		123.0
6.3	108.5	114.0		126.0
8.0	110.5	116.5		129.0
10.0	113.0	118.5		131.5
12.5	115.5	121.0		134.0
16.0	117.5	123.0	N	135.5
20.0	119.5	134.0	O	137.5
25.0	121.5	135.0		137.5
31.5	123.5	139.0	T	138.0
40.0	125.5	140.5		139.0
50.0	127.5	133.5		139.0
63.0	129.0	133.0		139.5
80.0	131.0	135.0		140.0
100.0	132.5	136.0	A	140.5
125.0	133.5	137.5	P	141.0
160.0	134.5	138.5		141.5
200.0	134.5	139.0	P	141.5
250.0	134.0	139.0		141.5
315.0	134.0	139.0	L	141.5
400.0	132.5	138.0		140.5
500.0	131.0	137.0	I	139.0
630.0	129.5	136.0		137.0
800.0	127.5	134.5	C	134.5
1000.0	126.0	133.5		133.0
1250.0	124.0	132.5	A	130.5
1600.0	122.0	131.0		128.0
2000.0	120.5	130.0	B	126.0
2500.0	118.5	128.5		123.5
3150.0	116.0	127.0	L	120.5
4000.0	113.5	125.0		117.5
5000.0	111.5	123.5	E	115.0
6300.0	108.5	121.5		111.5
8000.0	106.0	119.5		109.0
10000.0	104.0	118.0		105.5
Overall SPL	144.0	150.0		152.5
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Input to the Integrated Electronics Assembly (IEA) Located Between The Webs  
of the SRB/ET Aft Attach Ring

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.01  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.04  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.007  $g^2/Hz$

Composite = 6.1  $g_{rms}$

Qualification/Acceptance Test Criteria (5 min/axis)

20 Hz @ 0.028  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.11  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.02  $g^2/Hz$

Composite = 10.3  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

Radial Axis

20 - 50 Hz @ 0.030  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.090  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 8.5  $g_{rms}$

Long. and Tang. Axes

20 - 50 Hz @ 0.015  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.045  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0028  $g^2/Hz$

Composite = 6.0  $g_{rms}$

Input to the Integrated Electronics Assembly (IEA) Located Between the Webs  
of the SRB/ET Aft Attach Ring (Cont.)

3. Reentry Random Vibration Criteria (60 seconds plus 30 seconds/mission in each axis)

Radial Axis

20 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
20 - 30 Hz @ +3 dB/oct  
30 - 70 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
70 - 100 Hz @ -10 dB/oct  
100 - 500 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0056 \text{ g}^2/\text{Hz}$

Composite =  $9.5 \text{ g}_{\text{rms}}$

Tangential Axis

20 - 30 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
30 - 50 Hz @ -13 dB/oct  
50 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0028 \text{ g}^2/\text{Hz}$

Composite =  $6.2 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 80 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
80 - 150 Hz @ -7 dB/oct  
150 - 750 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.006 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

4. Flight Random Vibration Delta Qualification Criteria (80 seconds plus 40 seconds per mission)

Longitudinal Axis

20 - 40 Hz @  $0.002 \text{ g}^2/\text{Hz}$   
40 - 90 Hz @ +18.5 dB/oct  
90 - 110 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
110 - 200 Hz @ -17 dB/oct  
200 - 600 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -11.5 dB/oct  
2000 Hz @  $0.001 \text{ g}^2/\text{Hz}$

Composite =  $4.7 \text{ g}_{\text{rms}}$

Input to the Integrated Electronics Assembly (IEA) Located Between The Webs  
of the SRB/ET Aft Attach Ring (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
8 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
1.7 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the Integrated Electronics Assembly (IEA) Located Between The Webs  
of the SRB/ET Aft Attach Ring (Cont.)

6. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-Flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	120.0	137.0		136.0
6.3	121.0	138.0		137.0
8.0	122.0	139.0		138.0
10.0	123.5	140.0		139.5
12.5	125.0	141.0	N	140.5
16.0	126.0	142.0		141.5
20.0	127.5	142.5	O	142.5
25.0	129.0	143.0		144.0
31.5	130.0	143.5	T	145.0
40.0	131.5	144.0		146.0
50.0	132.5	144.0		147.0
63.0	133.5	144.0		148.5
80.0	134.0	144.5	A	149.5
100.0	134.5	144.5		150.0
125.0	135.0	144.0	P	150.5
160.0	135.5	143.0		151.0
200.0	135.5	143.0	P	151.0
250.0	135.5	142.5		151.0
315.0	135.0	142.0	L	151.0
400.0	135.0	141.0		150.5
500.0	134.5	140.0	I	149.5
630.0	134.0	139.0		149.0
800.0	133.5	138.0	C	148.0
1000.0	133.0	137.0		146.5
1250.0	132.5	136.0	A	145.5
1600.0	132.0	134.5		144.5
2000.0	131.5	133.0	B	143.0
2500.0	131.0	131.5		142.0
3150.0	130.0	130.0	L	141.0
4000.0	129.0	128.5		140.0
5000.0	128.0	126.5	E	139.0
6300.0	127.0	125.0		138.0
8000.0	126.0	124.0		137.0
10000.0	125.0	123.0		136.0
Overall SPL	147.5	55.0		162.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

Input to the Aft Integrated Electronics Assembly (IEA) Isolation System

1. Acceptance Test Criteria (5 min/axis)\*

20 Hz @ 0.01  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.04  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.007  $g^2/Hz$

Composite = 6.1  $g_{rms}$

\*Input to IEA in hardmount configuration

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

Radial Axis

20 - 100 Hz @ 0.003  $g^2/Hz$   
100 - 300 Hz @ +12.5 dB/oct  
300 - 400 Hz @ 0.3  $g^2/Hz$   
400 - 2000 Hz @ -15 dB/oct  
2000 Hz @ 0.0001  $g^2/Hz$

Composite = 8.8  $g_{rms}$

Longitudinal Axis

20 - 85 Hz @ 0.003  $g^2/Hz$   
85 - 155 Hz @ +17.5 dB/oct  
155 - 600 Hz @ 0.1  $g^2/Hz$   
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.008  $g^2/Hz$

Composite = 9.3  $g_{rms}$

Tangential Axis

20 - 65 Hz @ 0.002  $g^2/Hz$   
65 - 200 Hz @ +10.5 dB/oct  
200 - 400 Hz @ 0.1  $g^2/Hz$   
400 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.0005  $g^2/Hz$

Composite = 6.5  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 200 Hz @ 0.05  $g^2/Hz$   
200 - 300 Hz @ +13 dB/oct  
300 - 600 Hz @ 0.30  $g^2/Hz$   
600 - 2000 Hz @ -14 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 12.7  $g_{rms}$

Longitudinal Axis

20 - 50 Hz @ 0.015  $g^2/Hz$   
50 - 300 Hz @ +6 dB/oct  
300 - 700 Hz @ 0.4  $g^2/Hz$   
700 - 2000 Hz @ -8 dB/oct  
2000 Hz @ 0.02  $g^2/Hz$

Composite = 18.4  $g_{rms}$



Input to the Aft Integrated Electronics Assembly (IEA) Isolation System (Cont.)

3. Continued

Tangential Axis

20 - 100 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
100 - 200 Hz @ +10 dB/oct  
200 - 400 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.0005 \text{ g}^2/\text{Hz}$

Composite =  $6.5 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
8 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
1.7 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the Integrated Electronics Assembly (IEA) Multiple Locations (Aft  
Attach Ring and Forward Skirt Reaction Ring)

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.01  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.04  $g^2/Hz$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.007  $g^2/Hz$

Composite = 6.1  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

X Axis (Perp. to Ends)

20 Hz @ 0.016  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 85 Hz @ 0.026  $g^2/Hz$   
85 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.045  $g^2/Hz$   
500 - 650 Hz @ -6 dB/oct  
650 - 950 Hz @ 0.026  $g^2/Hz$   
950 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 6.7  $g_{rms}$

Y Axis (Perp. to Sides)

20 Hz @ 0.01  $g^2/Hz$   
20 - 130 Hz @ +3 dB/oct  
130 - 600 Hz @ 0.065  $g^2/Hz$   
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 7.8  $g_{rms}$

Z Axis (Perp. to Bottom)

20 - 50 Hz @ 0.03  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.09  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 8.5  $g_{rms}$

Input to the Integrated Electronics Assembly (IEA) Multiple Locations (Aft Attach Ring and Forward Skirt Reaction Ring) (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

X Axis (Perpendicular to Ends)

20 - 30 Hz @ 0.15  $g^2/Hz$   
30 - 34 Hz @ -12 dB/oct  
34 - 150 Hz @ 0.09  $g^2/Hz$   
150 - 180 Hz @ -11 dB/oct  
180 - 500 Hz @ 0.045  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.003  $g^2/Hz$

Composite = 6.8  $g_{rms}$

Y Axis (Perpendicular to Sides)

20 Hz @ 0.05  $g^2/Hz$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 80 Hz @ 0.2  $g^2/Hz$   
80 - 120 Hz @ -7.5 dB/oct  
120 - 200 Hz @ 0.075  $g^2/Hz$   
200 - 250 Hz @ -5.5 dB/oct  
250 - 700 Hz @ 0.05  $g^2/Hz$   
700 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.006  $g^2/Hz$

Composite = 5.3  $g_{rms}$

Z Axis (Perpendicular to Bottom)

20 Hz @ 0.2  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 70 Hz @ 0.3  $g^2/Hz$   
70 - 100 Hz @ -10 dB/oct  
100 - 500 Hz @ 0.09  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0056  $g^2/Hz$

Composite = 9.5  $g_{rms}$

4. Flight Random Vibration Delta Qualification Criteria (80 sec plus 40 sec/mission)

Y Axis (Perpendicular to Sides)

20 - 40 Hz @ 0.002  $g^2/Hz$   
40 - 90 Hz @ +18.5 dB/oct  
90 - 110 Hz @ 0.30  $g^2/Hz$   
110 - 200 Hz @ -17 dB/oct  
200 - 600 Hz @ 0.01  $g^2/Hz$   
600 - 2000 Hz @ -11.5 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 4.7  $g_{rms}$

Input to the Integrated Electronics Assembly (IEA) Multiple Locations (Aft  
Attach Ring and Forward Skirt Reaction Ring) (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the Integrated Electronics Assembly (IEA) Multiple Locations (Aft Attach  
Ring and Forward Reaction Ring) (Cont.)

6. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	120.0	137.0		136.0
6.3	121.0	138.0		137.0
8.0	122.0	139.0		138.0
10.0	123.5	140.0		139.5
12.5	125.0	141.0		140.5
16.0	126.0	142.0	N	141.5
20.0	127.5	142.5		142.5
25.0	129.0	143.0	O	144.0
31.5	130.0	143.5		145.0
40.0	131.5	144.0	T	146.0
50.0	132.5	144.0		147.0
63.0	133.5	144.0		148.0
80.0	134.0	144.5		149.5
100.0	134.5	144.5	A	150.0
125.0	135.0	144.0		150.5
160.0	135.5	143.0	P	151.0
200.0	135.5	143.0		151.0
250.0	135.5	142.5	P	151.0
315.0	135.0	142.0		151.0
400.0	135.0	141.0	L	150.5
500.0	134.5	140.0		149.5
630.0	134.0	139.0	I	149.0
800.0	133.5	138.0		147.5
1000.0	133.0	137.0	C	146.5
1250.0	132.5	136.0		145.5
1600.0	132.0	134.5	A	144.5
2000.0	131.5	133.0		143.0
2500.0	131.0	131.5	B	142.0
3150.0	130.0	130.0		141.0
4000.0	129.0	128.5	L	140.0
5000.0	128.0	126.5		139.0
6300.0	127.0	125.0	E	138.0
8000.0	126.0	124.0		137.0
10000.0	125.0	123.0		136.0
Overall SPL	147.5	155.0		162.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

## Input to the IEA Multiplexer Interface Adapter (MIA)

### 1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.032  $g^2/Hz$   
20 - 300 Hz @ +4 dB/oct  
300 - 800 Hz @ 1.00  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 29.7  $g_{rms}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 Hz @ 0.13  $g^2/Hz$   
20 - 300 Hz @ +4 dB/oct  
300 - 800 Hz @ 4.00  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.10  $g^2/Hz$

Composite = 59.5  $g_{rms}$

### 3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

20 Hz @ 0.13  $g^2/Hz$   
20 - 300 Hz @ +4 dB/oct  
300 - 800 Hz @ 4.00  $g^2/Hz$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.10  $g^2/Hz$

Composite = 59.5  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

#### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the IEA Multiplexer Interface Adapter (MIA) (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 - 50 Hz @ 12 G's peak  
100 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

# Input to the IEA Multiplexer Interface Adapter (MIA) (Cont.)

## 6. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-Flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>	<u>Reentry</u>
5.0	99.0	116.0		115.0
6.3	100.0	117.0		116.0
8.0	101.0	118.0		117.0
10.0	102.5	119.0		118.5
12.5	104.0	120.0	N	119.5
16.0	105.0	121.0		120.5
20.0	106.5	121.5	O	121.5
25.0	108.0	122.0		123.0
31.5	109.0	122.5	T	124.0
40.0	110.5	123.0		125.0
50.0	111.5	123.0		126.0
63.0	112.5	123.0		127.5
80.0	113.0	123.5	A	128.5
100.0	113.5	123.5	P	129.0
125.0	114.0	123.0		129.5
160.0	114.5	122.0	P	130.0
200.0	114.5	122.0		130.0
250.0	114.5	121.5		130.0
315.0	114.0	121.0	L	130.0
400.0	114.0	120.0		129.5
500.0	113.5	119.0	I	128.5
630.0	113.0	119.0		128.0
800.0	112.5	117.0	C	126.5
1000.0	112.0	116.0		125.5
1250.0	111.0	115.0	A	124.5
1600.0	111.0	113.5		123.5
2000.0	110.5	112.0	B	122.0
2500.0	110.0	110.5		121.0
3150.0	109.0	109.0	L	120.0
4000.0	108.0	107.5		119.0
5000.0	107.0	105.5	E	118.0
6300.0	106.0	104.0		117.0
8000.0	105.0	103.0		116.0
10000.0	104.0	102.0		115.0
Overall SPL	126.5	134.0		141.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission



Input to the IEA Internal Components (Components Mounted to the Inside IEA Housing Except the Multiplexer De-Multiplexer)

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.032  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 500 Hz @ 0.12  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0078  $g^2/Hz$

Composite = 10.2  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 Hz @ 0.13  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 500 Hz @ 0.50  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.031  $g^2/Hz$

Composite = 20.4  $g_{rms}$

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

20 Hz @ 0.13  $g^2/Hz$   
20 - 80 Hz @ +3 dB/oct  
80 - 500 Hz @ 0.50  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.031  $g^2/Hz$

Composite = 20.4  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the IEA Internal Components (Components Mounted to the Inside IEA Housing Except the Multiplexer De-Multiplexer) (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec duration

Input to the IEA Internal Components (Components Mounted to the Inside IEA Housing Except the Multiplexer De-Multiplexer) (Cont.)

6. Acoustic Criteria

(One third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-Flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	111.0	128.0		127.0
6.3	112.0	129.0		128.0
8.0	113.0	130.0		129.0
10.0	114.5	131.0		130.5
12.5	116.0	132.0	N	131.5
16.0	117.0	133.0		132.5
20.0	118.5	133.5	O	133.5
25.0	120.0	134.0		135.0
31.5	121.0	134.5	T	136.0
40.0	122.5	135.0		137.0
50.0	123.5	135.0		138.0
63.0	124.5	135.0		139.5
80.0	125.0	135.5	A	140.5
100.0	125.5	135.5		141.0
125.0	126.0	135.0	P	141.5
160.0	126.5	134.0		142.0
200.0	126.5	134.0	P	142.0
250.0	126.5	133.5		142.0
315.0	126.0	133.0	L	142.0
400.0	126.0	132.0		141.5
500.0	125.5	131.0	I	140.5
630.0	125.0	130.0		140.0
800.0	124.5	129.0	C	138.5
1000.0	124.0	129.0		137.5
1250.0	123.0	127.0	A	136.5
1600.0	123.0	125.5		135.5
2000.0	122.5	124.0	B	134.0
2500.0	122.0	122.5		133.0
3150.0	121.0	121.0	L	132.0
4000.0	120.0	119.5		131.0
5000.0	119.0	117.5	E	130.0
6300.0	118.0	116.0		129.0
8000.0	117.0	115.0		128.0
10000.0	116.0	114.0		127.0
Overall SPL	138.5	146.0		153.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

## Input to the IEA Multiplexer De-Multiplexer (MDM) Assembly

### 1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.01  $g^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.04  $g^2/\text{Hz}$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.007  $g^2/\text{Hz}$

Composite = 6.1  $g_{\text{rms}}$

### Qualification/Acceptance Test Criteria (5 min/axis)

20 Hz @ 0.028  $g^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 350 Hz @ 0.11  $g^2/\text{Hz}$   
350 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.02  $g^2/\text{Hz}$

Composite = 10.3  $g_{\text{rms}}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission)

#### X Axis (Parallel with MTG. Flange)

20 Hz @ 0.10  $g^2/\text{Hz}$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/\text{Hz}$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/\text{Hz}$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/\text{Hz}$

Composite = 14.5  $g_{\text{rms}}$

#### Y Axis (Perp. to Top Cover)

20 Hz @ 0.10  $g^2/\text{Hz}$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/\text{Hz}$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/\text{Hz}$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/\text{Hz}$

Composite = 14.6  $g_{\text{rms}}$

#### Z Axis (Perp. to MTG. Flange)

20 Hz @ 0.10  $g^2/\text{Hz}$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/\text{Hz}$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/\text{Hz}$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/\text{Hz}$

Composite = 10.7  $g_{\text{rms}}$

Input to the IEA Multiplexer De-Multiplexer (MDM) Assembly (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission)

X Axis (Parallel with MTG. Flange)

20 Hz @ 0.10  $g^2/Hz$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/Hz$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/Hz$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/Hz$

Composite = 14.5  $g_{rms}$

Y Axis (Perp. to Top Cover)

20 Hz @ 0.10  $g^2/Hz$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/Hz$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/Hz$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/Hz$

Composite = 14.6  $g_{rms}$

Z Axis (Perp. to MTG. Flange)

20 Hz @ 0.10  $g^2/Hz$   
20 - 50 Hz @ +4.5 dB/oct  
50 - 130 Hz @ 0.40  $g^2/Hz$   
130 - 160 Hz @ -12.5 dB/oct  
160 - 650 Hz @ 0.17  $g^2/Hz$   
650 - 2000 Hz @ -5.5 dB/oct  
2000 Hz @ 0.022  $g^2/Hz$

Composite = 10.7  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

\* Design Criteria Only

# Input to the IEA Multiplexer De-Multiplexer (MDM) Assembly (Cont.)

## B. Water Landing

### Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

### Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

## C. Parachute Deployment

### Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

### Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

## 6. Acoustic Criteria

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-Flight Fluctuating Pressure	Oscillating Shock	Reentry
5.0	111.0	128.0		127.0
6.3	112.0	129.0		128.0
8.0	113.0	130.0		129.0
10.0	114.5	131.0		130.5
12.5	116.0	132.0	N	131.5
16.0	117.0	133.0		132.5
20.0	118.5	133.5	O	133.5
25.0	120.0	134.0		135.0
31.5	121.0	134.5	T	136.0
40.0	122.5	135.0		137.0
50.0	123.5	135.0		138.0
63.0	124.5	135.0		139.5
80.0	125.0	135.5	A	140.5
100.0	125.5	135.5		141.0
125.0	126.0	135.0	P	141.5
160.0	126.5	134.0		142.0
200.0	126.5	134.0	P	142.0
250.0	126.5	133.5		142.0
315.0	126.0	133.0	L	142.0
400.0	126.0	132.0		141.5
500.0	125.5	131.0	I	140.5
630.0	125.0	130.0		140.0
800.0	124.5	129.0	C	138.5
1000.0	124.0	128.0		137.5
1250.0	123.0	127.0	A	136.5
1600.0	123.0	125.5		135.5
2000.0	122.5	124.0	B	134.0
2500.0	122.0	122.5		133.0
3150.0	121.0	121.0	L	132.0
4000.0	120.0	119.5		131.0
5000.0	119.0	117.5	E	130.0
6300.0	118.0	116.0		129.0
8000.0	117.0	115.0		128.0
10000.0	116.0	114.0		127.0
Overall SPL	138.5	146.0		153.0
Duration	50 sec plus 10 sec per mission	80 sec plus 40 sec per mission		60 sec plus 30 sec per mission

## Input to the TVC System Upper Frame Assembly

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 55 Hz @ +6 dB/oct  
55 - 200 Hz @ 0.095  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.012  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0024  $g^2/Hz$

Composite = 5.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0035  $g^2/Hz$   
20 - 75 Hz @ +6 dB/oct  
75 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0080  $g^2/Hz$

Composite = 7.8  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 200 Hz @ 0.063  $g^2/Hz$   
200 - 285 Hz @ -12 dB/oct  
285 - 1200 Hz @ 0.015  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0090  $g^2/Hz$

Composite = 6.0  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 65 Hz @ +3 dB/oct  
65 - 1000 Hz @ 0.050  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 9.1  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 - 200 Hz @ 0.15  $g^2/Hz$   
200 - 343 Hz @ -9 dB/oct  
343 - 1050 Hz @ 0.030  $g^2/Hz$   
1050 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0083  $g^2/Hz$

Composite = 8.6  $g_{rms}$

#### Long. and Tang. Axes

20 - 120 Hz @ 0.060  $g^2/Hz$   
120 - 385 Hz @ +2 dB/oct  
385 - 980 Hz @ 0.13  $g^2/Hz$   
980 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.031  $g^2/Hz$

Composite = 13.2  $g_{rms}$

Input to the TVC System Upper Frame Assembly (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
20 - 55 Hz @ +6 dB/oct  
55 - 200 Hz @ 0.38  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0097  $g^2/Hz$

Composite = 11.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.014  $g^2/Hz$   
20 - 75 Hz @ +6 dB/oct  
75 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.032  $g^2/Hz$

Composite = 15.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

\* Design Criteria Only



Input to the TVC System Upper Frame Assembly (Cont.)

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Auxiliary Propulsion Unit Isolation System

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
20 - 47 Hz @ +9 dB/oct  
47 - 77 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
77 - 150 Hz @ +12 dB/oct  
150 - 250 Hz @  $2.50 \text{ g}^2/\text{Hz}$   
250 - 545 Hz @ -15 dB/oct  
545 - 2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $23.5 \text{ g}_{\text{rms}}$

#### Longitudinal Axis

20 Hz @  $0.006 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +9 dB/oct  
60 - 200 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ +12 dB/oct  
300 - 400 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
400 - 500 Hz @ -15 dB/oct  
500 - 1000 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.06 \text{ g}^2/\text{Hz}$

Composite =  $20.8 \text{ g}_{\text{rms}}$

#### Tangential Axis

20 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 125 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
125 - 300 Hz @ +6 dB/oct  
300 - 400 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
400 - 670 Hz @ -15 dB/oct  
670 - 2000 Hz @  $0.04 \text{ g}^2/\text{Hz}$

Composite =  $14.1 \text{ g}_{\text{rms}}$

Input to Auxiliary Propulsion Unit Isolation System (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 0.024  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 84 Hz @ 0.15  $g^2/Hz$   
84 - 150 Hz @ +12 dB/oct  
150 - 250 Hz @ 1.50  $g^2/Hz$   
250 - 430 Hz @ -15 dB/oct  
430 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 21.0  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 50 Hz @ +12 dB/oct  
50 - 270 Hz @ 0.40  $g^2/Hz$   
270 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @ 0.70  $g^2/Hz$   
400 - 490 Hz @ -15 dB/oct  
490 - 1000 Hz @ 0.25  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.063  $g^2/Hz$

Composite = 21.7  $g_{rms}$

Tangential Axis

20 Hz @ 0.018  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 200 Hz @ 0.11  $g^2/Hz$   
200 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @ 0.80  $g^2/Hz$   
400 - 670 Hz @ -15 dB/oct  
670 - 2000 Hz @ 0.060  $g^2/Hz$

Composite = 16.9  $g_{rms}$

Input to Auxiliary Propulsion Unit Isolation System (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @ 0.12  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 78 Hz @ 0.18  $g^2/Hz$   
78 - 170 Hz @ +12 dB/oct  
170 - 250 Hz @ 4.00  $g^2/Hz$   
250 - 460 Hz @ -15 dB/oct  
460 - 2000 Hz @ 0.18  $g^2/Hz$

Composite = 31.1  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.12  $g^2/Hz$   
20 - 50 Hz @ +4 dB/oct  
50 - 155 Hz @ 0.40  $g^2/Hz$   
155 - 615 Hz @ +2 dB/oct  
615 - 900 Hz @ 1.00  $g^2/Hz$   
900 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.092  $g^2/Hz$

Composite = 32.0  $g_{rms}$

Tangential Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 75 Hz @ 0.15  $g^2/Hz$   
75 - 152 Hz @ +2 dB/oct  
152 - 195 Hz @ 0.24  $g^2/Hz$   
195 - 300 Hz @ +12 dB/oct  
300 - 440 Hz @ 1.30  $g^2/Hz$   
440 - 680 Hz @ -15 dB/oct  
680 - 2000 Hz @ 0.13  $g^2/Hz$

Composite = 24.0  $g_{rms}$

Input to Auxiliary Propulsion Unit Isolation System (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.054  $g^2/Hz$   
20 - 47 Hz @ +9 dB/oct  
47 - 77 Hz @ 0.70  $g^2/Hz$   
77 - 150 Hz @ +12 dB/oct  
150 - 250 Hz @ 10.0  $g^2/Hz$   
250 - 545 Hz @ -15 dB/oct  
545 - 2000 Hz @ 0.20  $g^2/Hz$

Composite = 47.0  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.022  $g^2/Hz$   
20 - 60 Hz @ +9 dB/oct  
60 - 200 Hz @ 0.60  $g^2/Hz$   
200 - 300 Hz @ +12 dB/oct  
300 - 400 Hz @ 3.00  $g^2/Hz$   
400 - 500 Hz @ -15 dB/oct  
500 - 1000 Hz @ 1.00  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.25  $g^2/Hz$

Composite = 41.5  $g_{rms}$

Tangential Axis

20 Hz @ 0.022  $g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 125 Hz @ 0.35  $g^2/Hz$   
125 - 300 Hz @ +6 dB/oct  
300 - 400 Hz @ 2.00  $g^2/Hz$   
400 - 670 Hz @ -15 dB/oct  
670 - 2000 Hz @ 0.15  $g^2/Hz$

Composite = 28.1  $g_{rms}$

## Input to Pump

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 - 61 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
61 - 80 Hz @ +9 dB/oct  
80 - 200 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
200 - 404 Hz @ -12 dB/oct  
404 - 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $8.8 \text{ g}_{\text{rms}}$

#### Longitudinal Axis

20 Hz @  $0.03 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 70 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
70 - 221 Hz @ -6 dB/oct  
221 - 2000 Hz @  $0.045 \text{ g}^2/\text{Hz}$

Composite =  $10.8 \text{ g}_{\text{rms}}$

#### Tangential Axis

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 70 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
70 - 125 Hz @ -12 dB/oct  
125 - 2000 Hz @  $0.03 \text{ g}^2/\text{Hz}$

Composite =  $8.5 \text{ g}_{\text{rms}}$

Input to Pump (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 70 Hz @ +6 dB/oct  
70 - 210 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
210 - 365 Hz @ -12 dB/oct  
365 - 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $8.5 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.064 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +6 dB/oct  
50 - 70 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
70 - 105 Hz @ -9 dB/oct  
105 - 300 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
300 - 433 Hz @ -9 dB/oct  
433 - 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $10.8 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 100 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
100 - 194 Hz @ -9 dB/oct  
194 - 2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $8.7 \text{ g}_{\text{rms}}$

Input to Pump (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 - 70 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
70 - 79 Hz @ +9 dB/oct  
79 - 200 Hz @  $1.00 \text{ g}^2/\text{Hz}$   
200 - 405 Hz @ -12 dB/oct  
405 - 2000 Hz @  $0.060 \text{ g}^2/\text{Hz}$

Composite =  $17.8 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +4 dB/oct  
50 - 70 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
70 - 213 Hz @ -4 dB/oct  
213 - 2000 Hz @  $0.16 \text{ g}^2/\text{Hz}$

Composite =  $18.9 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +4 dB/oct  
40 - 70 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
70 - 126 Hz @ -9 dB/oct  
126 - 2000 Hz @  $0.060 \text{ g}^2/\text{Hz}$

Composite =  $11.7 \text{ g}_{\text{rms}}$



## Input to Pump (Cont.)

### 1. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

#### Radial Axis

20 Hz @ 0.082  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 200 Hz @ 1.00  $g^2/Hz$   
200 - 404 Hz @ -12 dB/oct  
404 - 2000 Hz @ 0.060  $g^2/Hz$

Composite = 17.5  $g_{rms}$

#### Longitudinal Axis

20 Hz @ 0.12  $g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 70 Hz @ 1.80  $g^2/Hz$   
70 - 221 Hz @ -6 dB/oct  
221 - 2000 Hz @ 0.18  $g^2/Hz$

Composite = 21.5  $g_{rms}$

#### Tangential Axis

20 Hz @ 0.077  $g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 70 Hz @ 1.20  $g^2/Hz$   
70 - 125 Hz @ -12 dB/oct  
125 - 2000 Hz @ 0.12  $g^2/Hz$

Composite = 16.9  $g_{rms}$

### 5. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

#### Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

Input to Pump (Cont.)

6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mech. test methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to HP Filter

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.03  $g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 117 Hz @ 0.50  $g^2/Hz$   
117 - 150 Hz @ +15 dB/oct  
150 - 200 Hz @ 1.75  $g^2/Hz$   
200 - 355 Hz @ -15 dB/oct  
355 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 20.1  $g_{rms}$

#### Longitudinal Axis

20 Hz @ 0.005  $g^2/Hz$   
20 - 250 Hz @ +6 dB/oct  
250 - 500 Hz @ 0.75  $g^2/Hz$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 20.6  $g_{rms}$

#### Tangential Axis

20 Hz @ 0.004  $g^2/Hz$   
20 - 50 Hz @ +12 dB/oct  
50 - 230 Hz @ 0.18  $g^2/Hz$   
230 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @ 0.63  $g^2/Hz$   
400 - 575 Hz @ -15 dB/oct  
575 - 1330 Hz @ 0.10  $g^2/Hz$   
1330 - 1600 Hz @ +15 dB/oct  
1600 - 2000 Hz @ 0.25  $g^2/Hz$

Composite = 19.7  $g_{rms}$

Input to HP Filter (Cont.)

1. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 0.028  $g^2/Hz$   
20 - 100 Hz @ +6 dB/oct  
100 - 200 Hz @ 0.70  $g^2/Hz$   
200 - 325 Hz @ -12 dB/oct  
325 - 1080 Hz @ 0.10  $g^2/Hz$   
1080 - 1300 Hz @ +15 dB/oct  
1300 - 2000 Hz @ 0.25  $g^2/Hz$

Composite = 20.4  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.025  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 66 Hz @ 0.050  $g^2/Hz$   
66 - 100 Hz @ +15 dB/oct  
100 - 500 Hz @ 0.40  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 17.8  $g_{rms}$

Tangential Axis

20 Hz @ 0.020  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 225 Hz @ 0.10  $g^2/Hz$   
225 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @ 0.40  $g^2/Hz$   
400 - 585 Hz @ -15 dB/oct  
585 - 1160 Hz @ 0.060  $g^2/Hz$   
1160 - 1600 Hz @ +15 dB/oct  
1600 - 2000 Hz @ 0.30  $g^2/Hz$

Composite = 18.1  $g_{rms}$

### Input to HP Filter (Cont.)

#### 2. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.15  $g^2/Hz$   
20 - 50 Hz @ +4 dB/oct  
50 - 105 Hz @ 0.50  $g^2/Hz$   
105 - 155 Hz @ +9 dB/oct  
155 - 200 Hz @ 1.60  $g^2/Hz$   
200 - 380 Hz @ -12 dB/oct  
380 - 1000 Hz @ 0.12  $g^2/Hz$   
1000 - 1200 Hz @ +12 dB/oct  
1200 - 2000 Hz @ 0.25  $g^2/Hz$

Composite = 23.6  $g_{rms}$

##### Longitudinal Axis

20 - 125 Hz @ 0.15  $g^2/Hz$   
125 - 300 Hz @ +9 dB/oct  
300 - 570 Hz @ 2.00  $g^2/Hz$   
570 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.047  $g^2/Hz$

Composite = 35.1  $g_{rms}$

##### Tangential Axis

20 Hz @ 0.067  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 80 Hz @ 0.10  $g^2/Hz$   
80 - 120 Hz @ +3 dB/oct  
120 - 210 Hz @ 0.15  $g^2/Hz$   
210 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @ 0.85  $g^2/Hz$   
400 - 540 Hz @ -15 dB/oct  
540 - 1180 Hz @ 0.19  $g^2/Hz$   
1180 - 1600 Hz @ +15 dB/oct  
1600 - 2000 Hz @ 0.85  $g^2/Hz$

Composite = 29.3  $g_{rms}$

Input to HP Filter (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 117 Hz @  $2.00 \text{ g}^2/\text{Hz}$   
117 - 150 Hz @ +15 dB/oct  
140 - 200 Hz @  $7.00 \text{ g}^2/\text{Hz}$   
200 - 355 Hz @ -15 dB/oct  
355 - 2000 Hz @  $0.40 \text{ g}^2/\text{Hz}$

Composite =  $40.2 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
20 - 250 Hz @ +6 dB/oct  
250 - 500 Hz @  $3.00 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.046 \text{ g}^2/\text{Hz}$

Composite =  $11.2 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +12 dB/oct  
50 - 230 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
230 - 300 Hz @ +15 dB/oct  
300 - 400 Hz @  $2.50 \text{ g}^2/\text{Hz}$   
400 - 575 Hz @ -15 dB/oct  
575 - 1330 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
1330 - 1600 Hz @ +15 dB/oct  
1600 - 2000 Hz @  $1.00 \text{ g}^2/\text{Hz}$

Composite =  $39.4 \text{ g}_{\text{rms}}$

Input to HP Filter (Cont.)

6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction of equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

Input to Fuel Isolation Valve

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.033  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 200 Hz @ 0.30  $g^2/Hz$   
200 - 400 Hz @ -6 dB/oct  
400 - 2000 Hz @ 0.075  $g^2/Hz$

Composite = 14.1  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.007  $g^2/Hz$   
20 - 500 Hz @ +4 dB/oct  
500 - 800 Hz @ 0.50  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.033  $g^2/Hz$

Composite = 20.6  $g_{rms}$

Tangential Axis

20 Hz @ 0.011  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 200 Hz @ 0.12  $g^2/Hz$   
200 - 360 Hz @ +9 dB/oct  
360 - 700 Hz @ 0.75  $g^2/Hz$   
700 - 1075 Hz @ -15 dB/oct  
1075 - 2000 Hz @ 0.09  $g^2/Hz$

Composite = 22.9  $g_{rms}$



Input to Fuel Isolation Valve (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 0.029  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 120 Hz @ 0.18  $g^2/Hz$   
120 - 160 Hz @ -6 dB/oct  
160 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 14.3  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.032  $g^2/Hz$   
20 - 250 Hz @ +3 dB/oct  
250 - 700 Hz @ 0.40  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.017  $g^2/Hz$

Composite = 18.8  $g_{rms}$

Tangential Axis

20 Hz @ 0.018  $g^2/Hz$   
20 - 90 Hz @ +2 dB/oct  
90 - 200 Hz @ 0.050  $g^2/Hz$   
200 - 313 Hz @ +12 dB/oct  
313 - 600 Hz @ 0.30  $g^2/Hz$   
600 - 1470 Hz @ -6 dB/oct  
1470 - 2000 Hz @ 0.050  $g^2/Hz$

Composite = 15.6  $g_{rms}$

Input to Fuel Isolation Valve (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.13  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 80 Hz @ 0.20  $g^2/Hz$   
80 - 112 Hz @ +3 dB/oct  
112 - 220 Hz @ 0.28  $g^2/Hz$   
220 - 395 Hz @ -2 dB/oct  
395 - 2000 Hz @ 0.19  $g^2/Hz$

Composite = 19.9  $g_{rms}$

Longitudinal Axis

20 - 110 Hz @ 0.15  $g^2/Hz$   
110 - 247 Hz @ +6 dB/oct  
247 - 700 Hz @ 0.75  $g^2/Hz$   
700 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.065  $g^2/Hz$

Composite = 26.6  $g_{rms}$

Tangential Axis

20 - 155 Hz @ 0.10  $g^2/Hz$   
155 - 304 Hz @ +9 dB/oct  
304 - 650 Hz @ 0.75  $g^2/Hz$   
650 - 1175 Hz @ -6 dB/oct  
1175 - 2000 Hz @ 0.23  $g^2/Hz$

Composite = 27.1  $g_{rms}$

Input to Fuel Isolation Valve (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 200 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
200 - 400 Hz @ -6 dB/oct  
400 - 2000 Hz @  $0.30 \text{ g}^2/\text{Hz}$

Composite =  $28.1 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
20 - 500 Hz @ +4 dB/oct  
500 - 800 Hz @  $2.00 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.13 \text{ g}^2/\text{Hz}$

Composite =  $41.2 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.042 \text{ g}^2/\text{Hz}$   
20 - 70 Hz @ +6 dB/oct  
70 - 200 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
200 - 360 Hz @ +9 dB/oct  
360 - 700 Hz @  $3.00 \text{ g}^2/\text{Hz}$   
700 - 1075 Hz @ -15 dB/oct  
1075 - 2000 Hz @  $0.35 \text{ g}^2/\text{Hz}$

Composite =  $45.8 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

Input to

6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction of equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to the TVC System Lower Frame Assembly

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 45 Hz @ +6 dB/oct  
45 - 200 Hz @ 0.065  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.0085  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0014  $g^2/Hz$

Composite = 4.8  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0035  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 800 Hz @ 0.032  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0052  $g^2/Hz$

Composite = 6.4  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 - 200 Hz @ 0.10  $g^2/Hz$   
200 - 343 Hz @ -9 dB/oct  
343 - 1050 Hz @ 0.02  $g^2/Hz$   
1050 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0055  $g^2/Hz$

Composite = 7.0  $g_{rms}$

#### Longitudinal and Tangential Axes

20 - 75 Hz @ 0.04  $g^2/Hz$   
75 - 150 Hz @ +5 dB/oct  
150 - 400 Hz @ 0.13  $g^2/Hz$   
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.016  $g^2/Hz$

Composite = 10.1  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 - 200 Hz @ 0.10  $g^2/Hz$   
200 - 343 Hz @ -9 dB/oct  
343 - 1050 Hz @ 0.020  $g^2/Hz$   
1050 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0055  $g^2/Hz$

Composite = 7.0  $g_{rms}$

#### Long. and Tang. Axes

20 - 125 Hz @ 0.040  $g^2/Hz$   
125 - 424 Hz @ +2 dB/oct  
424 - 960 Hz @ 0.090  $g^2/Hz$   
960 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.021  $g^2/Hz$

Composite = 10.8  $g_{rms}$

Input to the TVC System Lower Frame Assembly (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.052  $g^2/Hz$   
20 - 45 Hz @ +6 dB/oct  
45 - 200 Hz @ 0.26  $g^2/Hz$   
200 - 395 Hz @ -9 dB/oct  
395 - 800 Hz @ 0.34  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0055  $g^2/Hz$

Composite = 9.7  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.014  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 800 Hz @ 0.13  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.021  $g^2/Hz$

Composite = 12.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

\* Design Criteria Only

Input to the TVC System Lower Frame Assembly (Cont.)

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Manifest

### 1. Acceptance Test Criteria (1 min/axis,

#### Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
20 - 56 Hz @ +9 dB/oct  
56 - 89 Hz @ 0.33  $g^2/Hz$   
89 - 150 Hz @ +11 dB/oct  
150 - 250 Hz @ 2.50  $g^2/Hz$   
250 - 500 Hz @ -17 dB/oct  
500 - 2000 Hz @ 0.05  $g^2/Hz$

Composite = 23.3  $g_{rms}$

#### Longitudinal Axis

20 Hz @ 0.013  $g^2/Hz$   
20 - 50 Hz @ +8 dB/oct  
50 - 200 Hz @ 0.12  $g^2/Hz$   
200 - 250 Hz @ +13 dB/oct  
250 - 350 Hz @ 0.35  $g^2/Hz$   
350 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.006  $g^2/Hz$

Composite = 12.3  $g_{rms}$

#### Tangential Axis

20 Hz @ 0.009  $g^2/Hz$   
20 - 50 Hz @ +12 dB/oct  
50 - 500 Hz @ 0.37  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 17.7  $g_{rms}$



Input to Manifold (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 0.017  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 95 Hz @ 0.15  $g^2/Hz$   
95 - 150 Hz @ +15 dB/oct  
150 - 250 Hz @ 1.50  $g^2/Hz$   
250 - 590 Hz @ -15 dB/oct  
590 - 985 Hz @ 0.020  $g^2/Hz$   
985 - 1300 Hz @ +15 dB/oct  
1300 - 2000 Hz @ 0.080  $g^2/Hz$

Composite = 19.0  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 50 Hz @ +7 dB/oct  
50 - 350 Hz @ 0.40  $g^2/Hz$   
350 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.014  $g^2/Hz$

Composite = 15.4  $g_{rms}$

Tangential Axis

20 Hz @ 0.032  $g^2/Hz$   
20 - 50 Hz @ +6 dB/oct  
50 - 500 Hz @ 0.20  $g^2/Hz$   
500 - 1290 Hz @ -6 dB/oct  
1290 - 2000 Hz @ 0.030  $g^2/Hz$

Composite = 13.3  $g_{rms}$

### Input to Manifold (Cont.)

#### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.13  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 72 Hz @ 0.19  $g^2/Hz$   
72 - 155 Hz @ +12 dB/oct  
155 - 250 Hz @ 4.00  $g^2/Hz$   
250 - 640 Hz @ -13 dB/oct  
640 - 1050 Hz @ 0.060  $g^2/Hz$   
1050 - 1295 Hz @ +15 dB/oct  
1295 - 2000 Hz @ 0.17  $g^2/Hz$

Composite = 31.0  $g_{rms}$

##### Longitudinal Axis

20 Hz @ 0.19  $g^2/Hz$   
20 - 40 Hz @ +2 dB/oct  
40 - 120 Hz @ 0.30  $g^2/Hz$   
120 - 250 Hz @ +2.5 dB/oct  
250 - 400 Hz @ 0.58  $g^2/Hz$   
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.023  $g^2/Hz$

Composite = 19.0  $g_{rms}$

##### Tangential Axis

20 Hz @ 0.19  $g^2/Hz$   
20 - 40 Hz @ +2 dB/oct  
40 - 72 Hz @ 0.30  $g^2/Hz$   
72 - 258 Hz @ +2 dB/oct  
258 - 600 Hz @ 0.70  $g^2/Hz$   
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.064  $g^2/Hz$

Composite = 25.4  $g_{rms}$

Input to Manifold (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.059  $g^2/Hz$   
20 - 56 Hz @ +9 dB/oct  
56 - 89 Hz @ 1.30  $g^2/Hz$   
89 - 150 Hz @ +11 dB/oct  
150 - 250 Hz @ 10.0  $g^2/Hz$   
250 - 500 Hz @ -17 dB/oct  
500 - 2000 Hz @ 0.20  $g^2/Hz$

Composite = 46.5  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.051  $g^2/Hz$   
20 - 50 Hz @ +8 dB/oct  
50 - 200 Hz @ 0.50  $g^2/Hz$   
200 - 250 Hz @ +13 dB/oct  
250 - 350 Hz @ 1.40  $g^2/Hz$   
350 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 24.6  $g_{rms}$

Tangential Axis

20 Hz @ 0.038  $g^2/Hz$   
20 - 50 Hz @ +12 dB/oct  
50 - 500 Hz @ 1.50  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.098  $g^2/Hz$

Composite = 35.3  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

Input to Manifold (Cont.)

6. Shock Test Criteria (2 shocks/axis)

Test will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Reservoir

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 200 Hz @ 1.25  $g^2/Hz$   
200 - 650 Hz @ -9 dB/oct  
650 - 2000 Hz @ 0.038  $g^2/Hz$

Composite = 17.9  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0018  $g^2/Hz$   
20 - 150 Hz @ +9 dB/oct  
150 - 300 Hz @ 0.75  $g^2/Hz$   
300 - 590 Hz @ -9 dB/oct  
590 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 19.1  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 - 52 Hz @ 0.050  $g^2/Hz$   
52 - 110 Hz @ +18 dB/oct  
110 - 180 Hz @ 5.00  $g^2/Hz$   
180 - 580 Hz @ -9 dB/oct  
580 - 2000 Hz @ 0.15  $g^2/Hz$

Composite = 32.3  $g_{rms}$

#### Long. and Tang. Axes

20 - 60 Hz @ 0.050  $g^2/Hz$   
60 - 140 Hz @ +12 dB/oct  
140 - 300 Hz @ 1.50  $g^2/Hz$   
300 - 590 Hz @ -9 dB/oct  
590 - 2000 Hz @ 0.20  $g^2/Hz$

Composite = 27.1  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 - 59 Hz @ 0.12  $g^2/Hz$   
59 - 110 Hz @ +18 dB/oct  
110 - 200 Hz @ 5.00  $g^2/Hz$   
200 - 645 Hz @ -9 dB/oct  
645 - 2000 Hz @ 0.15  $g^2/Hz$

Composite = 34.5  $g_{rms}$

#### Long. and Tang. Axes

20 - 72 Hz @ 0.090  $g^2/Hz$   
72 - 167 Hz @ +12 dB/oct  
167 - 310 Hz @ 2.60  $g^2/Hz$   
310 - 580 Hz @ -9 dB/oct  
580 - 2000 Hz @ 0.40  $g^2/Hz$

Composite = 36.3  $g_{rms}$

### Input to Reservoir (Cont.)

#### 4. Entry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.041  $g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 200 Hz @ 5.00  $g^2/Hz$   
200 - 650 Hz @ -9 dB/oct  
650 - 2000 Hz @ 0.15  $g^2/Hz$

Composite = 35.8  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.0072  $g^2/Hz$   
20 - 150 Hz @ +9 dB/oct  
150 - 300 Hz @ 3.00  $g^2/Hz$   
300 - 590 Hz @ -9 dB/oct  
590 - 2000 Hz @ 0.40  $g^2/Hz$

Composite = 38.2  $g_{rms}$

#### 5. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

#### 6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

##### A. Nozzle Severance

No shock test required.

\* Design Criteria Only

Input to Reservoir (Cont.)

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Fuel Supply Module (Cont.)

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 250 Hz @ 1.25  $g^2/Hz$   
250 - 450 Hz @ -12 dB/oct  
450 - 1000 Hz @ 0.12  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.016  $g^2/Hz$

Composite = 20.5  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0018  $g^2/Hz$   
20 - 180 Hz @ +9 dB/oct  
180 - 300 Hz @ 1.25  $g^2/Hz$   
300 - 565 Hz @ -12 dB/oct  
565 - 2000 Hz @ 0.10  $g^2/Hz$

Composite = 21.3  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0080  $g^2/Hz$   
20 - 100 Hz @ +12 dB/oct  
100 - 150 Hz @ 5.00  $g^2/Hz$   
150 - 600 Hz @ -9 dB/oct  
600 - 2000 Hz @ 0.080  $g^2/Hz$

Composite = 28.6  $g_{rms}$

#### Long. and Tang. Axes

20 - 70 Hz @ 0.050  $g^2/Hz$   
70 - 120 Hz @ +18 dB/oct  
120 - 300 Hz @ 1.40  $g^2/Hz$   
300 - 630 Hz @ -9 dB/oct  
630 - 2000 Hz @ 0.15  $g^2/Hz$

Composite = 25.4  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 - 40 Hz @ 0.12  $g^2/Hz$   
40 - 102 Hz @ +12 dB/oct  
102 - 190 Hz @ 5.00  $g^2/Hz$   
190 - 600 Hz @ -9 dB/oct  
600 - 2000 Hz @ 0.16  $g^2/Hz$

Composite = 34.6  $g_{rms}$

#### Long. and Tang. Axes

20 - 80 Hz @ 0.090  $g^2/Hz$   
80 - 135 Hz @ +18 dB/oct  
135 - 350 Hz @ 2.00  $g^2/Hz$   
350 - 500 Hz @ -12 dB/oct  
500 - 2000 Hz @ 0.30  $g^2/Hz$

Composite = 32.8  $g_{rms}$



Input to Fuel Supply Module (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.040  $g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 250 Hz @ 5.00  $g^2/Hz$   
250 - 450 Hz @ -12 dB/oct  
450 - 1000 Hz @ 0.50  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.065  $g^2/Hz$

Composite = 41.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0070  $g^2/Hz$   
20 - 180 Hz @ +9 dB/oct  
180 - 300 Hz @ 5.00  $g^2/Hz$   
300 - 565 Hz @ -12 dB/oct  
565 - 2000 Hz @ 0.40  $g^2/Hz$

Composite = 42.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

\* Design Criteria Only

Input to Fuel Supply Module (Cont.)

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Fuel Supply Module OFI Pressure Sensor

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0019  $g^2/Hz$   
20 - 100 Hz @ +12 dB/oct  
100 - 150 Hz @ 1.25  $g^2/Hz$   
150 - 715 Hz @ -12 dB/oct  
715 - 1150 Hz @ 0.0025  $g^2/Hz$   
1150 - 1500 Hz @ +15 dB/oct  
1500 - 2000 Hz @ 0.010  $g^2/Hz$

Composite = 12.5  $g_{rms}$

#### Longitudinal Axis

20 Hz @ 0.000052  $g^2/Hz$   
20 - 150 Hz @ +15 dB/oct  
150 - 250 Hz @ 1.25  $g^2/Hz$   
250 - 1100 Hz @ -9 dB/oct  
1100 - 2000 Hz @ 0.015  $g^2/Hz$

Composite = 17.8  $g_{rms}$

#### Tangential Axis

20 Hz @ 0.00016  $g^2/Hz$   
20 - 120 Hz @ +15 dB/oct  
120 - 250 Hz @ 1.25  $g^2/Hz$   
250 - 1180 Hz @ -12 dB/oct  
1180 - 2000 Hz @ 0.0025  $g^2/Hz$

Composite = 17.1  $g_{rms}$

Input to Fuel Supply Module OFI Pressure Sensor (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 - 45 Hz @ 0.040  $g^2/Hz$   
45 - 100 Hz @ +18 dB/oct  
100 - 150 Hz @ 5.00  $g^2/Hz$   
150 - 720 Hz @ -12 dB/oct  
720 - 1200 Hz @ 0.010  $g^2/Hz$   
1200 - 1500 Hz @ +15 dB/oct  
1500 - 2000 Hz @ 0.030  $g^2/Hz$

Composite = 24.3  $g_{rms}$

Longitudinal Axis

20 - 65 Hz @ 0.040  $g^2/Hz$   
65 - 150 Hz @ +9 dB/oct  
150 - 400 Hz @ 0.50  $g^2/Hz$   
400 - 775 Hz @ -9 dB/oct  
775 - 2000 Hz @ 0.070  $g^2/Hz$

Composite = 17.4  $g_{rms}$

Tangential Axis

20 - 58 Hz @ 0.040  $g^2/Hz$   
58 - 130 Hz @ +18 dB/oct  
130 - 225 Hz @ 5.00  $g^2/Hz$   
225 - 1000 Hz @ -12 dB/oct  
1000 - 2000 Hz @ 0.015  $g^2/Hz$

Composite = 31.0  $g_{rms}$

Input to Fuel Supply Module OFI Pressure Sensor (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 49 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
49 - 104 Hz @ +15 dB/oct  
104 - 150 Hz @  $5.00 \text{ g}^2/\text{Hz}$   
150 - 713 Hz @ -12 dB/oct  
713 - 1150 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
1150 - 1520 Hz @ +15 dB/oct  
1520 - 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $24.5 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 - 92 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
92 - 185 Hz @ +15 dB/oct  
185 - 290 Hz @  $3.00 \text{ g}^2/\text{Hz}$   
290 - 1100 Hz @ -3 dB/oct  
1100 - 2000 Hz @  $0.06 \text{ g}^2/\text{Hz}$

Composite =  $29.5 \text{ g}_{\text{rms}}$

Tangential Axis

20 - 65 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
65 - 130 Hz @ +18 dB/oct  
130 - 250 Hz @  $5.00 \text{ g}^2/\text{Hz}$   
250 - 1180 Hz @ -12 dB/oct  
1180 - 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $33.5 \text{ g}_{\text{rms}}$

Input to Fuel Supply Module OFI Pressure Sensor (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.0075  $g^2/Hz$   
20 - 100 Hz @ +12 dB/oct  
100 - 150 Hz @ 5.00  $g^2/Hz$   
150 - 715 Hz @ -12 dB/oct  
715 - 1150 Hz @ 0.010  $g^2/Hz$   
1150 - 1500 Hz @ +15 dB/oct  
1500 - 2000 Hz @ 0.040  $g^2/Hz$

Composite = 25.1  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.00021  $g^2/Hz$   
20 - 150 Hz @ +15 dB/oct  
150 - 250 Hz @ 5.00  $g^2/Hz$   
250 - 1100 Hz @ -9 dB/oct  
1100 - 2000 Hz @ 0.060  $g^2/Hz$

Composite = 35.7  $g_{rms}$

Tangential Axis

20 Hz @ 0.00066  $g^2/Hz$   
20 - 120 Hz @ +15 dB/oct  
120 - 250 Hz @ 5.00  $g^2/Hz$   
250 - 1180 Hz @ -12 dB/oct  
1180 - 2000 Hz @ 0.010  $g^2/Hz$

Composite = 34.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

Input to Fuel Supply Module OFI Pressure Sensor (Cont.)

6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

Input to Components on the Hydraulic Power Supply Service Panels

1. Acceptance Test Criteria (1 mil./axis)

Radial Axis

20 - 285 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
285 - 400 Hz @ -6 dB/oct  
400 - 715 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
715 - 900 Hz @ +9 dB/oct  
900 - 2000 Hz @  $0.50 \text{ g}^2/\text{Hz}$

Composite =  $29.5 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.005 \text{ g}^2/\text{Hz}$   
20 - 110 Hz @ +6 dB/oct  
110 - 160 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
160 - 270 Hz @ +12 dB/oct  
270 - 440 Hz @  $1.25 \text{ g}^2/\text{Hz}$   
440 - 530 Hz @ -15 dB/oct  
530 - 930 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
930 - 1115 Hz @ -15 dB/oct  
1115 - 2000 Hz @  $0.20 \text{ g}^2/\text{Hz}$

Composite =  $28.3 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.009 \text{ g}^2/\text{Hz}$   
20 - 130 Hz @ +6 dB/oct  
130 - 2000 Hz @  $0.375 \text{ g}^2/\text{Hz}$

Composite =  $26.8 \text{ g}_{\text{rms}}$



Input to Components on the Hydraulic Power Supply Service Panels (Cont.)

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 - 720 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
720 - 1000 Hz @ +12 dB/oct  
1000 - 1500 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.475 \text{ g}^2/\text{Hz}$

Composite =  $41.3 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
20 - 90 Hz @ +3 dB/oct  
90 - 140 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
140 - 250 Hz @ +12 dB/oct  
250 - 510 Hz @  $1.6 \text{ g}^2/\text{Hz}$   
510 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $33.5 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.03 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +6 dB/oct  
32 - 80 Hz @  $0.08 \text{ g}^2/\text{Hz}$   
80 - 135 Hz @ +9 dB/oct  
135 - 300 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
300 - 425 Hz @ -6 dB/oct  
425 - 1000 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
1000 - 1320 Hz @ +15 dB/oct  
1320 - 2000 Hz @  $0.80 \text{ g}^2/\text{Hz}$

Composite =  $30.8 \text{ g}_{\text{rms}}$

Input to Components on the Hydraulic Power Supply Service Panels (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.20  $g^2/Hz$   
20 - 200 Hz @ +2 dB/oct  
200 - 715 Hz @ 0.80  $g^2/Hz$   
715 - 900 Hz @ +12 dB/oct  
900 - 2000 Hz @ 2.0  $g^2/Hz$

Composite = 54.4  $g_{rms}$

Longitudinal Axis

20 - 135 Hz @ 0.13  $g^2/Hz$   
135 - 335 Hz @ +12 dB/oct  
335 - 665 Hz @ 5.0  $g^2/Hz$   
667 - 1100 Hz @ -15 dB/oct  
1100 - 2000 Hz @ 0.40  $g^2/Hz$

Composite = 55.5  $g_{rms}$

Tangential Axis

20 - 100 Hz @ 0.16  $g^2/Hz$   
100 - 135 Hz @ +9 dB/oct  
135 - 220 Hz @ 0.40  $g^2/Hz$   
200 - 220 Hz @ +12 dB/oct  
220 - 1075 Hz @ 0.60  $g^2/Hz$   
1075 - 1350 Hz @ +12 dB/oct  
1350 - 2000 Hz @ 1.50  $g^2/Hz$

Composite = 39.8  $g_{rms}$

Input to Components on the Hydraulic Power Supply Service Panels (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 285 Hz @ 2.0  $g^2/Hz$   
285 - 400 Hz @ -6 dB/oct  
400 - 715 Hz @ 1.0  $g^2/Hz$   
715 - 900 Hz @ +9 dB/oct  
900 - 2000 Hz @ 2.0  $g^2/Hz$

Composite = 59.0  $g_{rms}$

Longitudinal Axis

20 Hz @ 0.02  $g^2/Hz$   
20 - 110 Hz @ +6 dB/oct  
110 - 160 Hz @ 0.60  $g^2/Hz$   
160 - 270 Hz @ +12 dB/oct  
270 - 440 Hz @ 5.0  $g^2/Hz$   
440 - 530 Hz @ -15 dB/oct  
530 - 930 Hz @ 2.0  $g^2/Hz$   
930 - 1115 Hz @ -15 dB/oct  
1115 - 2000 Hz @ 0.80  $g^2/Hz$

Composite = 56.5  $g_{rms}$

Tangential Axis

20 Hz @ 0.035  $g^2/Hz$   
20 - 130 Hz @ +6 dB/oct  
130 - 2000 Hz @ 1.5  $g^2/Hz$

Composite = 53.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

## Input to Components on the Hydraulic Power Supply Service Panels (Cont.)

### 6. Shock Test Criteria (2 shocks/axis)

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Nozzle Severance

No shock test required.

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

##### Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

##### Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to the SRB Actuator Assembly (Nozzle Attach)

### 1. Acceptance Test Criteria (1 min/axis)

20 - 70 Hz @ 0.018  $g^2/\text{Hz}$   
70 - 114 Hz @ +12 dB/oct  
114 Hz @ 0.13  $g^2/\text{Hz}$   
114 - 250 Hz @ +2.5 dB/oct  
250 - 600 Hz @ 0.25  $g^2/\text{Hz}$   
600 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.0045  $g^2/\text{Hz}$

Composite = 13.3  $g_{\text{rms}}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 70 Hz @ 0.07  $g^2/\text{Hz}$   
70 - 114 Hz @ +12 dB/oct  
114 Hz @ 0.50  $g^2/\text{Hz}$   
114 - 250 Hz @ +2.5 dB/oct  
250 - 600 Hz @ 1.0  $g^2/\text{Hz}$   
600 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.018  $g^2/\text{Hz}$

Composite = 26.5  $g_{\text{rms}}$

### 3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0073  $g^2/\text{Hz}$   
20 - 70 Hz @ +12 dB/oct  
70 - 200 Hz @ 1.10  $g^2/\text{Hz}$   
200 - 650 Hz @ -15 dB/oct  
650 - 1400 Hz @ 0.0030  $g^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0015  $g^2/\text{Hz}$

Composite = 14.7  $g_{\text{rms}}$

#### Long. and Tang. Axes

20 Hz @ 0.019  $g^2/\text{Hz}$   
20 - 50 Hz @ +6 dB/oct  
50 - 1400 Hz @ 0.12  $g^2/\text{Hz}$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.041  $g^2/\text{Hz}$

Composite = 14.4  $g_{\text{rms}}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 20 Hz @ 1.0 G's peak  
20 - 30 Hz @ 5.6 G's peak  
30 - 40 Hz @ 3.7 G's peak  
40 - 50 Hz @ 2.4 G's peak

#### Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 @ 3.7 G's peak

\* Design Criteria Only

Input to the SRB Actuator Assembly (Nozzle Attach) (Cont.)

5 Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

50 Hz @ 938 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 3,750 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 150,000 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

# Input to the SRB Actuator Assembly (Aft Skirt Attach)

## 1. Acceptance Test Criteria (1 min/axis)

### Radial Axis

20 - 36 Hz @ 0.50  $g^2/Hz$   
36 - 62 Hz @ -13 dB/oct  
62 - 225 Hz @ 0.045  $g^2/Hz$   
225 - 385 Hz @ -9 dB/oct  
385 - 800 Hz @ 0.009  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0015  $g^2/Hz$

Composite = 5.6  $g_{rms}$

### Long. and Tang. Axes

20 - 36 Hz @ 0.14  $g^2/Hz$   
36 - 57 Hz @ -10 dB/oct  
57 - 800 Hz @ 0.03  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.005  $g^2/Hz$

Composite = 6.4  $g_{rms}$

## 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

### Radial Axis

20 Hz @ 0.014  $g^2/Hz$   
20 - 35 Hz @ +6 dB/oct  
35 - 200 Hz @ 0.043  $g^2/Hz$   
200 - 280 Hz @ -12 dB/oct  
280 - 1200 Hz @ 0.010  $g^2/Hz$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0062  $g^2/Hz$

Composite = 5.0  $g_{rms}$

### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 1000 Hz @ 0.024  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 6.3  $g_{rms}$

## 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

### Radial Axis

20 - 200 Hz @ 0.068  $g^2/Hz$   
200 - 360 Hz @ -12 dB/oct  
360 - 1000 Hz @ 0.0068  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0034  $g^2/Hz$

Composite = 5.0  $g_{rms}$

### Long. and Tang. Axes

20 - 800 Hz @ 0.022  $g^2/Hz$   
800 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0088  $g^2/Hz$

Composite = 5.8  $g_{rms}$

Input to the SRB Actuator Assembly (Aft Skirt Attach) (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 36 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
36 - 62 Hz @ -13 dB/oct  
62 - 225 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
225 - 385 Hz @ -9 dB/oct  
385 - 800 Hz @  $0.036 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0058 \text{ g}^2/\text{Hz}$   
Composite =  $11.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 36 Hz @  $0.54 \text{ g}^2/\text{Hz}$   
36 - 57 Hz @ -10 dB/oct  
57 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct

Composite =  $12.7 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only



Input to the SRB Actuator Assembly (Aft Skirt Attach) (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

See Input to the SRB Actuator Assembly (Nozzle Attach)

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to Frustum Location Aid (FLA)

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 - 40 Hz @  $0.043 \text{ g}^2/\text{Hz}$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00078 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0015 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### Qualification Acceptance Test Criteria (5 min/axis)

#### Radial Axis

20 - 40 Hz @  $0.043 \text{ g}^2/\text{Hz}$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.00078 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0015 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
20 - 28 Hz @ +3 dB/oct  
28 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Input to the Frustum Location Aid (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 - 120 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @  $0.039 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0010 \text{ g}^2/\text{Hz}$

Composite =  $6.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @  $0.0051 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 40 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
40 - 50 Hz @ -6 dB/oct  
50 - 600 Hz @  $0.085 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0023 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 800 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0021 \text{ g}^2/\text{Hz}$

Composite =  $6.1 \text{ g}_{\text{rms}}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

## Input to the Frustum Location Aid (Cont.)

### 6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Forward Skirt/Frustum Separation

50 - 50 Hz @ 94 G's peak  
100 Hz @ +12 dB/oct  
100 Hz @ 375 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 15,000 G's peak

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

##### Lateral Axes

Half Sine Pulse  
15 G's peak Amplitude  
100 msec Duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
1.0 G's peak Amplitude  
300 msec Duration

##### Lateral Axes

Half Sine Pulse  
0.7 G's peak Amplitude  
300 msec Duration

## Input to the FLA Flashing Light

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 - 40 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
40 - 80 Hz @  $-10.5 \text{ dB/oct}$   
80 - 600 Hz @  $0.0088 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @  $-9 \text{ dB/oct}$   
2000 Hz @  $0.00025 \text{ g}^2/\text{Hz}$

Composite =  $3.5 \text{ g}_{\text{rms}}$

#### Tangential Axis

20 - 800 Hz @  $0.008 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @  $-9 \text{ dB/oct}$   
2000 Hz @  $0.00053 \text{ g}^2/\text{Hz}$

Composite =  $3.1 \text{ g}_{\text{rms}}$

#### Longitudinal Axis

20 - 60 Hz @  $0.008 \text{ g}^2/\text{Hz}$   
60 - 90 Hz @  $+8.5 \text{ dB/oct}$   
90 - 150 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
150 - 210 Hz @  $-12 \text{ dB/oct}$   
210 - 900 Hz @  $0.0063 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @  $-9 \text{ dB/oct}$   
2000 Hz @  $0.00053 \text{ g}^2/\text{Hz}$

Composite =  $3.1 \text{ g}_{\text{rms}}$

Input to the FLA Flashing Light (Cont.)

2. Lift-off Random Vibration (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 - 35 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
35 - 50 Hz @  $-9.5 \text{ dB/oct}$   
50 - 800 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @  $-12 \text{ dB/oct}$   
2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Longitudinal Axis

20 - 40 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
40 - 80 Hz @  $+8.5 \text{ dB/oct}$   
80 - 150 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
150 - 300 Hz @  $-7 \text{ dB/oct}$   
300 - 1000 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @  $-12 \text{ dB/oct}$   
2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Tangential Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @  $+3 \text{ dB/oct}$   
40 - 900 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @  $-12 \text{ dB/oct}$   
2000 Hz @  $0.00090 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### Input to FLA Flashing Light (Cont.)

#### 3. Boost Random Vibration (80 sec plus 40 sec/mission in each axis)

##### Radial Axis

20 - 40 Hz @ 0.04  $g^2/Hz$   
40 - 50 Hz @ -16 dB/oct  
50 - 120 Hz @ 0.012  $g^2/Hz$   
120 - 160 Hz @ +9 dB/oct  
160 - 900 Hz @ 0.025  $g^2/Hz$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 5.3  $g_{rms}$

##### Longitudinal Axis

20 Hz @ 0.0028  $g^2/Hz$   
20 - 90 Hz @ +4 dB/oct  
90 - 1100 Hz @ 0.020  $g^2/Hz$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0023  $g^2/Hz$

Composite = 5.3  $g_{rms}$

##### Tangential Axis

20 Hz @ 0.0028  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @ 0.0051  $g^2/Hz$   
120 - 180 Hz @ +9 dB/oct  
180 - 1100 Hz @ 0.0023  $g^2/Hz$   
1100 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.023  $g^2/Hz$

Composite = 5.0  $g_{rms}$

Input to the FLA Flashing Light (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 40 Hz @ 0.40  $g^2/Hz$   
40 - 80 Hz @ -10.5 dB/oct  
80 - 600 Hz @ 0.035  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.001  $g^2/Hz$

Composite = 6.4  $g_{rms}$

Longitudinal Axis

20 - 60 Hz @ 0.033  $g^2/Hz$   
60 - 90 Hz @ +8.5 dB/oct  
90 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 210 Hz @ -12 dB/oct  
210 - 900 Hz @ 0.025  $g^2/Hz$   
900 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0021  $g^2/Hz$

Composite = 6.2  $g_{rms}$

Tangential Axis

20 - 800 Hz @ 0.033  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0021  $g^2/Hz$

Composite = 6.1  $g_{rms}$



Input to the FLA Flashing Light (Cont.)

5. Vehicle Dynamics Criteria

Radial Axis

2 - 5 Hz @ 4.3 g's peak\*  
5 - 10 Hz @ 0.5 g's peak  
10 - 30 Hz @ 4.3 g's peak  
30 - 40 Hz @ 12 g's peak

Tangential Axis

2 - 5 Hz @ 4.3 g's peak\*  
5 - 10 Hz @ 0.5 g's peak  
10 - 35 Hz @ 4.3 g's peak  
35 - 40 Hz @ 8.0 g's peak

Longitudinal Axis

3.5 - 5 Hz @ 0.7 g's peak\*  
5 - 10 Hz @ 0.7 g's peak  
10 - 40 Hz @ 1.0 g's peak

\* Design Criteria Only

Input to the FLA Flashing Light (Cont.)

6. Shock Test Criteria

A. Forward Skirt/Frustum Separation (Shock Test once in each direction/axis/mission)

50 Hz @ 94 g's peak  
50 - 100 Hz @ 12 dB/oct  
100 Hz @ 357 g's peak  
100 - 1000 Hz @ +2.5 dB/oct  
1000 - 10000 Hz @ 1875 g's peak

B. Water Landing

Longitudinal Axis

Half sine pulse  
40 g's peak amplitude  
50 milliseconds duration

Lateral Axis

Half sine pulse  
15 g's peak amplitude  
100 milliseconds duration

C. Parachute Deployment

Longitudinal Axis

Half sine pulse  
1.0 g's peak amplitude  
300 milliseconds duration

Lateral Axis

Half sine pulse  
5.7 g's peak amplitude  
300 milliseconds duration

## Input to the Forward Skirt Beacon Transmitter

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0032  $g^2/Hz$

Composite = 6.8  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.020  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 5.4  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 310 Hz @ 0.054  $g^2/Hz$   
310 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.090  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0058  $g^2/Hz$

Composite = 9.2  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.060  $g^2/Hz$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @ 0.040  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 7.8  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite = 13.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.080  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 10.8  $g_{rms}$

Input to the Forward Skirt Beacon Transmitter (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 200 Hz @ 0.25  $g^2/Hz$   
200 - 260 Hz @ -6 dB/oct  
260 - 600 Hz @ 0.15  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0041  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.30  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0080  $g^2/Hz$

Composite = 9.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the Forward Skirt Beacon Transmitter (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

## Input to the Rate Gyro

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0032  $g^2/Hz$

Composite = 6.8  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.020  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 5.4  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 310 Hz @ 0.054  $g^2/Hz$   
310 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.090  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0058  $g^2/Hz$

Composite = 9.2  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.060  $g^2/Hz$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @ 0.040  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.010  $g^2/Hz$

Composite = 7.8  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.013  $g^2/Hz$

Composite = 13.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 1000 Hz @ 0.080  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2/Hz$

Composite = 10.8  $g_{rms}$

Input to the Rate Gyro (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 200 Hz @ 0.25  $g^2/Hz$   
200 - 258 Hz @ -6 dB/oct  
258 - 600 Hz @ 0.15  $g^2/Hz$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0041  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.060  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.30  $g^2/Hz$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0080  $g^2/Hz$

Composite = 9.6  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the Rate Gyro (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration



Input to the Separation Motor DFI Pressure Sensor

1. Acceptance Test Criteria (1 min/axis)

20 - 200 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ +6 dB/oct  
300 - 1000 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.12 \text{ g}^2/\text{Hz}$

Composite =  $21.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
20 - 32 Hz @ +3 dB/oct  
32 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
32 - 55 Hz @ +6 dB/oct  
55 - 200 Hz @  $0.077 \text{ g}^2/\text{Hz}$   
200 - 315 Hz @ +9 dB/oct  
315 - 1000 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $21.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

20 - 200 Hz @  $0.54 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ +6 dB/oct  
300 - 1000 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.48 \text{ g}^2/\text{Hz}$

Composite =  $42.0 \text{ g}_{\text{rms}}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

N/A

Input to the Separation Motor DFI Pressure Sensor (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 G's peak  
100 - 1,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3,750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
5.7 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

## Input to Separation Instrumentation Package

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0025  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 1000 Hz @ 0.050  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 8.0  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0040  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 150 Hz @ 0.050  $g^2/Hz$   
150 - 220 Hz @ -6 dB/oct  
220 - 1500 Hz @ 0.022  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 6.7  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0072  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 310 Hz @ 0.054  $g^2/Hz$   
310 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.090  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.014  $g^2/Hz$

Composite = 9.9  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.012  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 150 Hz @ 0.15  $g^2/Hz$   
150 - 270 Hz @ -6 dB/oct  
270 - 1500 Hz @ 0.046  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 10.1  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 400 Hz @ +3 dB/oct  
400 - 1000 Hz @ 0.20  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.050  $g^2/Hz$

Composite = 16.1  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 150 Hz @ 0.20  $g^2/Hz$   
150 - 220 Hz @ -6 dB/oct  
220 - 1500 Hz @ 0.090  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.050  $g^2/Hz$

Composite = 13.4  $g_{rms}$

Input to Separation Instrumentation Package (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 200 Hz @ 0.25  $g^2/Hz$   
200 - 258 Hz @ -6 dB/oct  
258 - 600 Hz @ 0.15  $g^2/Hz$   
600 - 1028 Hz @ -9 dB/oct  
1028 - 2000 Hz @ 0.030  $g^2/Hz$

Composite = 12.6  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.052  $g^2/Hz$   
20 - 100 Hz @ +5 dB/oct  
100 - 150 Hz @ 0.75  $g^2/Hz$   
150 - 258 Hz @ -15 dB/oct  
258 - 800 Hz @ 0.050  $g^2/Hz$   
800 - 943 Hz @ -6 dB/oct  
943 - 2000 Hz @ 0.036  $g^2/Hz$

Composite = 12.7  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to Separation Instrumentation Package (Cont.)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration



## Input to the Barometric Altitude Switch

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 - 60 Hz @ 0.012  $g^2$ /Hz  
60 - 163 Hz @ +3 dB/oct  
163 - 340 Hz @ 0.032  $g^2$ /Hz  
340 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00095  $g^2$ /Hz

Composite = 4.2  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.00070  $g^2$ /Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @ 0.0014  $g^2$ /Hz  
120 - 200 Hz @ +9 dB/oct  
200 - 1400 Hz @ 0.0075  $g^2$ /Hz  
1400 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0018  $g^2$ /Hz

Composite = 3.4  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.017  $g^2$ /Hz  
20 - 50 Hz @ +3 dB/oct  
50 - 700 Hz @ 0.040  $g^2$ /Hz  
700 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00069  $g^2$ /Hz

Composite = 6.0  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.011  $g^2$ /Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 1400 Hz @ 0.022  $g^2$ /Hz  
1400 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0053  $g^2$ /Hz

Composite = 6.0  $g_{rms}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

#### Radial Axis

20 - 120 Hz @ 0.0083  $g^2$ /Hz  
120 - 230 Hz @ +9 dB/oct  
230 - 670 Hz @ 0.054  $g^2$ /Hz  
670 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.00069  $g^2$ /Hz

Composite = 6.3  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0028  $g^2$ /Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 120 Hz @ 0.0056  $g^2$ /Hz  
120 - 200 Hz @ +9 dB/oct  
200 - 1400 Hz @ 0.030  $g^2$ /Hz  
1400 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0070  $g^2$ /Hz

Composite = 6.9  $g_{rms}$

Input to the Barometric Altitude Switch (Cont.)

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 60 Hz @ 0.048  $g^2/Hz$   
60 - 163 Hz @ +3 dB/oct  
163 - 340 Hz @ 0.13  $g^2/Hz$   
340 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 8.4  $g_{rms}$

Long. and Tang. Axes

20 - 1400 Hz @ 0.016  $g^2/Hz$   
1400 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0039  $g^2/Hz$

Composite = 5.2  $g_{rms}$

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

Input to the Barometric Altitude Switch (Cont)

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

Lateral Axes

Half Sine Pulse  
15 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
1.0 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
5.7 G's peak Amplitude  
300 msec Duration



## Input to the SRB Connectors\*

### 1. Acceptance Test Criteria (1 min/axis)

	20 Hz @ 0.75 g <sup>2</sup> /Hz
20 -	40 Hz @ +3 dB/oct
40 -	60 Hz @ 1.50 g <sup>2</sup> /Hz
60 -	73 Hz @ -6 dB/oct
73 -	97 Hz @ 1.00 g <sup>2</sup> /Hz
97 -	120 Hz @ +12 dB/oct
120 -	200 Hz @ 2.28 g <sup>2</sup> /Hz
200 -	235 Hz @ -15 dB/oct
235 -	660 Hz @ 1.00 g <sup>2</sup> /Hz
660 -	1050 Hz @ -9 dB/oct
1050 -	1400 Hz @ 0.25 g <sup>2</sup> /Hz
1400 -	2000 Hz @ -9 dB/oct
	2000 Hz @ 0.082 g <sup>2</sup> /Hz

Composite = 34.1 g<sub>rms</sub>

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

	20 Hz @ 0.22 g <sup>2</sup> /Hz
20 -	40 Hz @ +3 dB/oct
40 -	60 Hz @ 0.44 g <sup>2</sup> /Hz
60 -	109 Hz @ +3 dB/oct
109 -	165 Hz @ 0.80 g <sup>2</sup> /Hz
165 -	178 Hz @ +9 dB/oct
178 -	240 Hz @ 1.00 g <sup>2</sup> /Hz
240 -	253 Hz @ +15 dB/oct
253 -	650 Hz @ 1.30 g <sup>2</sup> /Hz
650 -	750 Hz @ +3 dB/oct
750 -	1200 Hz @ 1.50 g <sup>2</sup> /Hz
1200 -	2000 Hz @ -6 dB/oct
	2000 Hz @ 0.54 g <sup>2</sup> /Hz

Composite = 47.2 g<sub>rms</sub>

\* These random vibration criteria represent an envelope of the applicable zonal criteria. These criteria are inputs to components having attached connectors; therefore, the test setups should include component dynamic simulations.

Input to the SRB Connectors (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

20 Hz @ 3.00  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 6.00  $g^2/Hz$   
60 - 73 Hz @ -6 dB/oct  
73 - 97 Hz @ 4.00  $g^2/Hz$   
97 - 120 Hz @ +12 dB/oct  
120 - 200 Hz @ 9.12  $g^2/Hz$   
200 - 235 Hz @ -15 dB/oct  
235 - 660 Hz @ 4.00  $g^2/Hz$   
660 - 1050 Hz @ -9 dB/oct  
1050 - 1400 Hz @ 1.00  $g^2/Hz$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.33  $g^2/Hz$

Composite = 68.3  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

## Input to the SRB Connectors (Cont.)

### 5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Forward Skirt/Frustum Separation

50 - 50 Hz @ 188 G's peak  
100 - 100 Hz @ +12 dB/oct  
100 - 100 Hz @ 750 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 30,000 G's peak

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
40 G's peak Amplitude  
50 msec Duration

##### Lateral Axes

Half Sine Pulse  
30 G's peak Amplitude  
100 msec Duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
500 msec Duration

##### Lateral Axes

Half Sine Pulse  
5.7 G's peak Amplitude  
200 msec Duration

## Input to the SRM Safe and Arm Device

### 1. Acceptance Test Criteria (1 min/axis)

20 - 50 Hz @  $0.0050 \text{ g}^2/\text{Hz}$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.00095 \text{ g}^2/\text{Hz}$

Composite =  $3.4 \text{ g}_{\text{rms}}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0038 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

### 3. Reentry Random Vibration Criteria

Not Applicable

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

#### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the SRM Safe and Arm Device (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance Shock

No shock test required.

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

## Input to the SRB Parachute Reefing Line Cutters

### 1. Acceptance Test Criteria (1 min/axis)

20 - 50 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
400 - 770 Hz @ -9 dB/oct  
770 - 1000 Hz @  $0.0033 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0004 \text{ g}^2/\text{Hz}$

Composite =  $3.8 \text{ g}_{\text{rms}}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

20 - 1000 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -11 dB/oct  
2000 Hz @  $0.002 \text{ g}^2/\text{Hz}$

Composite =  $5.6 \text{ g}_{\text{rms}}$

### 3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

20 - 120 Hz @  $0.0083 \text{ g}^2/\text{Hz}$   
120 - 180 Hz @ +9 dB/oct  
180 - 800 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.00069 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

### 4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

20 - 50 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
50 - 60 Hz @ -6 dB/oct  
60 - 400 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
400 - 770 Hz @ -9 dB/oct  
770 - 1000 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0017 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

### 5. Vehicle Dynamics Criteria

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 4.3 G's peak

\* Design Criteria Only

## Input to the SRB System Tunnel

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0019  $g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 140 Hz @ 0.028  $g^2/Hz$   
140 - 200 Hz @ +13 dB/oct  
200 - 300 Hz @ 0.13  $g^2/Hz$   
300 - 2000 Hz @ -10.5 dB/oct  
2000 Hz @ 0.00015  $g^2/Hz$

Composite = 5.8  $g_{rms}$

#### Long. and Tang. Axes

20 - 50 Hz @ 0.005  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.015  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00095  $g^2/Hz$

Composite = 3.5  $g_{rms}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 - 50 Hz @ 0.020  $g^2/Hz$   
50 - 150 Hz @ +3 dB/oct  
150 - 500 Hz @ 0.060  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 6.9  $g_{rms}$

### 3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.0075  $g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 140 Hz @ 0.11  $g^2/Hz$   
140 - 200 Hz @ +13 dB/oct  
200 - 300 Hz @ 0.5  $g^2/Hz$   
300 - 2000 Hz @ -10.5 dB/oct  
2000 Hz @ 0.0006  $g^2/Hz$

Composite = 11.6  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0025  $g^2/Hz$   
20 - 80 Hz @ +7 dB/oct  
80 - 200 Hz @ 0.069  $g^2/Hz$   
200 - 680 Hz @ -6.5 dB/oct  
680 - 2000 Hz @ 0.0047  $g^2/Hz$

Composite = 5.0  $g_{rms}$

## Input to the SRB System Tunnel (Cont.)

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G peak\*  
5 - 40 Hz @ 1.0 G peak

#### Lateral Axes

2 - 5 Hz @ 1.7 G peak\*  
5 - 10 Hz @ 0.60 G peak  
10 - 40 Hz @ 1.7 G peak

\* Design Criteria Only

### 5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

#### A. Ordnance Shock

No shock test required.

#### B. Water Landing

##### Longitudinal Axis

Half Sine Pulse  
20 G Peak Amplitude  
150 msec Duration

##### Lateral Axes

Half Sine Pulse  
8 G Peak Amplitude  
100 msec Duration

#### C. Parachute Deployment

##### Longitudinal Axis

Half Sine Pulse  
3.6 G Peak Amplitude  
500 msec Duration

##### Lateral Axes

Half Sine Pulse  
1.7 G Peak Amplitude  
300 msec Duration



# SRB FWC SYSTEMS TUNNEL REENTRY FLUCTUATING PRESSURE

## PROTUBERANCE CRITERIA

(One-third octave band acoustic specification in dB re.  $20 \mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Sound Pressure Level (dB)
5.0	146.0
6.0	148.0
8.0	149.5
10.0	151.0
12.0	152.0
16.0	154.0
20.0	155.0
25.0	155.5
31.0	156.0
40.0	156.0
50.0	156.0
63.0	156.0
80.0	155.5
100.0	155.0
125.0	155.0
160.0	154.5
200.0	154.0
250.0	153.5
315.0	153.0
400.0	152.0
500.0	151.0
630.0	150.0
800.0	148.0
1000.0	146.5
1250.0	144.0
1600.0	142.0
2000.0	139.0
2500.0	136.0
3150.0	133.0
4000.0	130.0
5000.0	127.0
6000.0	124.0
8000.0	121.0
10000.0	118.5

Overall SPL 167.5

Duration: 60 sec plus 30 sec/mission

## Input to SRB Range Safety Integrated Receiver/Decoder (IRD)

### 1. Acceptance Test Criteria (3 min/axis)

#### Radial Axis

20 Hz @ 0.16  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 250 Hz @ 0.24  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.04  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.02  $g^2/Hz$

Composite = 11.5  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.03  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 150 Hz @ 0.06  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @ 0.12  $g^2/Hz$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.17  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.05  $g^2/Hz$

Composite = 14.5  $g_{rms}$

### 2. Qualification/Acceptance Criteria (7 min/axis)

#### Radial Axis

20 Hz @ 0.27  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 250 Hz @ 0.40  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.070  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.034  $g^2/Hz$

Composite = 14.9  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.28  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.085  $g^2/Hz$

Composite = 18.8  $g_{rms}$

### 3. Liftoff Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

#### Radial Axis

20 Hz @ 0.10  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 250 Hz @ 0.20  $g^2/Hz$   
250 - 470 Hz @ -9 dB/oct  
470 - 1000 Hz @ 0.030  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0075  $g^2/Hz$

Composite = 9.7  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @ 0.10  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 12.1  $g_{rms}$

### Input to SRB Range Safety Integrated Receiver/Decoder (IRD) (Cont.)

#### 4. Boost Random Vibration Criteria (80 sec plus 1 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.27  $g^2/Hz$   
20 - 30 Hz @ +3 dB/oct  
30 - 250 Hz @ 0.40  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.070  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.034  $g^2/Hz$

Composite = 14.9  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.050  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 150 Hz @ 0.10  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @ 0.20  $g^2/Hz$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.28  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.085  $g^2/Hz$

Composite = 18.8  $g_{rms}$

#### 5. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

##### Radial Axis

20 Hz @ 0.38  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @ 1.20  $g^2/Hz$   
90 - 115 Hz @ -12 dB/oct  
115 - 250 Hz @ 0.44  $g^2/Hz$   
250 - 550 Hz @ -12 dB/oct  
550 - 1000 Hz @ 0.020  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0050  $g^2/Hz$

Composite = 13.9  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.54  $g^2/Hz$   
20 - 34 Hz @ +3 dB/oct  
34 - 50 Hz @ 0.90  $g^2/Hz$   
50 - 80 Hz @ -12 dB/oct  
80 - 450 Hz @ 0.15  $g^2/Hz$   
450 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.034  $g^2/Hz$

Composite = 13.8  $g_{rms}$

#### 6. Random Vibration Test Tolerances

a. Acceptance Test Criteria: +1 dB, -3 dB

b. Qualification/Acceptance and Qualification Criteria: +3 dB, -1 dB

#### 7. Vehicle Dynamics Criteria

##### Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

##### Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.6 G's peak  
10 - 40 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to SRB Range Safety Integrated Receiver/Decoder (IRD) (Cont.)

8. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Forward Skirt/Frustum Separation

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4000 - 10,000 Hz @ 1875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

Input to the SRM Nozzle Linear Shaped Charge (LSC) and the Flexible Confined Detonating Cord (FCDC)

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.0095  $g^2/Hz$   
20 - 800 Hz @ +3 dB/oct  
800 - 1200 Hz @ 0.38  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.14  $g^2/Hz$

Composite = 21.8  $g_{rms}$

2. Flight Random Vibration Criteria (4 min plus 2 min/mission in each axis)

20 Hz @ 0.038  $g^2/Hz$   
20 - 800 Hz @ +3 dB/oct  
800 - 1200 Hz @ 1.5  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.55  $g^2/Hz$

Composite = 43.6  $g_{rms}$

3. Reentry Random Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 - 50 Hz @ 0.30  $g^2/Hz$   
50 - 70 Hz @ +12 dB/oct  
70 - 200 Hz @ 1.1  $g^2/Hz$   
200 - 650 Hz @ -15 dB/oct  
650 - 1400 Hz @ 0.003  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0015  $g^2/Hz$

Composite = 14.9  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.24  $g^2/Hz$   
40 - 60 Hz @ -5.5 dB/oct  
60 - 1400 Hz @ 0.12  $g^2/Hz$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.041  $g^2/Hz$

Composite = 14.6  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 0.7 G's peak\*  
5 - 10 Hz @ 0.7 G's peak  
10 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 2.0 G's peak\*  
5 - 10 Hz @ 0.5 G's peak  
10 - 40 Hz @ 3.7 G's peak

\* Design Criteria Only

Input to the SRM Nozzle Linear Shaped Charge (LSC) and the Flexible Confined Detonating Cord (FCDC) (Cont.)

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Nozzle Severance

Not applicable.

B. Water Landing

Not applicable.

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
3.4 G's peak Amplitude  
300 msec Duration

## Input to the ET/SRB Range Safety Antenna

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.0065  $g^2/Hz$   
20 - 250 Hz @ +6 dB/oct  
250 - 600 Hz @ 1.0  $g^2/Hz$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0083  $g^2/Hz$

Composite = 25.1  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0058  $g^2/Hz$   
20 - 60 Hz @ +6 dB/oct  
60 - 270 Hz @ 0.05  $g^2/Hz$   
270 - 450 Hz @ +12 dB/oct  
450 - 700 Hz @ 0.38  $g^2/Hz$   
700 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0065  $g^2/Hz$

Composite = 14.9  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

#### Radial Axis

20 Hz @ 0.010  $g^2/Hz$   
20 - 110 Hz @ +6 dB/oct  
110 - 350 Hz @ 0.30  $g^2/Hz$   
350 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @ 1.00  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.16  $g^2/Hz$

Composite = 30.6  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.0026  $g^2/Hz$   
20 - 60 Hz @ +10 dB/oct  
60 - 205 Hz @ 0.10  $g^2/Hz$   
205 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @ 0.50  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.082  $g^2/Hz$

Composite = 22.8  $g_{rms}$

Input to the ET/SRM Range Safety Antenna (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @ 0.11  $g^2/\text{Hz}$   
20 - 64 Hz @ +6 dB/oct  
64 - 320 Hz @ 1.0  $g^2/\text{Hz}$   
320 - 400 Hz @ +9 dB/oct  
400 - 300 Hz @ 2.0  $g^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.058  $g^2/\text{Hz}$

Composite = 41.1  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.023  $g^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 270 Hz @ 0.2  $g^2/\text{Hz}$   
270 - 450 Hz @ +12 dB/oct  
450 - 700 Hz @ 1.5  $g^2/\text{Hz}$   
700 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.026  $g^2/\text{Hz}$

Composite = 29.7  $g_{\text{rms}}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.026  $g^2/\text{Hz}$   
20 - 250 Hz @ +6 dB/oct  
250 - 600 Hz @ 4.00  $g^2/\text{Hz}$   
600 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.033  $g^2/\text{Hz}$

Composite = 50.2  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.080  $g^2/\text{Hz}$   
150 - 225 Hz @ -9 dB/oct  
225 - 1000 Hz @ 0.023  $g^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0058  $g^2/\text{Hz}$

Composite = 6.4  $g_{\text{rms}}$



Input to the ET/SRB Range Safety Antenna (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. RS Antenna Ordnance Shock Input Criteria

All Axis

50 - 50 Hz @ 12 G's peak  
100 - 100 Hz @ -12 dB/oct  
100 - 100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

## Input to the ET/SRB Range Safety Batteries

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.50  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 1.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.15  $g^2/Hz$   
136 - 156 Hz @ -18 dB/oct  
156 - 750 Hz @ 0.063  $g^2/Hz$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.004  $g^2/Hz$

Composite = 9.8  $g_{rms}$

#### Long. and Tang. Axes

20 - 44 Hz @ 0.033  $g^2/Hz$   
44 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @ 0.075  $g^2/Hz$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @ 0.025  $g^2/Hz$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.005  $g^2/Hz$

Composite = 5.2  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

#### Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 200 Hz @ -18 dB/oct  
200 - 330 Hz @ 0.06  $g^2/Hz$   
330 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @ 0.09  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 15.9  $g_{rms}$

#### Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
40 - 63 Hz @ -9 dB/oct  
63 Hz @ 0.037  $g^2/Hz$   
63 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @ 0.06  $g^2/Hz$   
150 - 180 Hz @ -6 dB/oct  
180 - 1000 Hz @ 0.040  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.01  $g^2/Hz$

Composite = 7.9  $g_{rms}$

Input to ET/SRB Range Safety Batteries (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @  $4.0 \text{ g}^2/\text{Hz}$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
136 - 156 Hz @ -18 dB/oct  
156 - 750 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
750 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $19.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 44 Hz @  $0.133 \text{ g}^2/\text{Hz}$   
44 - 100 Hz @ +3 dB/oct  
100 - 180 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
180 - 410 Hz @ -4 dB/oct  
410 - 900 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.02 \text{ g}^2/\text{Hz}$

Composite =  $10.3 \text{ g}_{\text{rms}}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 200 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
200 - 260 Hz @ -6 dB/oct  
260 - 600 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0041 \text{ g}^2/\text{Hz}$

Composite =  $11.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +3 dB/oct  
100 - 150 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
150 - 235 Hz @ -12 dB/oct  
235 - 800 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0080 \text{ g}^2/\text{Hz}$

Composite =  $9.6 \text{ g}_{\text{rms}}$

Input to the ET/SRB Range Safety Batteries (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

## Input to the ET/SRB Range Safety Couplers, Receiver, Decoder

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.5  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 1.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.15  $g^2/Hz$   
136 - 146 Hz @ -18 dB/oct  
146 - 250 Hz @ 0.1  $g^2/Hz$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @ 0.018  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0085  $g^2/Hz$

Composite = 9.0  $g_{rms}$

#### Long. and Tang. Axes

20 - 40 Hz @ 0.033  $g^2/Hz$   
40 - 44 Hz @ -9 dB/oct  
55 - 136 Hz @ 0.15  $g^2/Hz$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @ 0.05  $g^2/Hz$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @ 0.07  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.021  $g^2/Hz$

Composite = 9.4  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

#### Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
50 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 165 Hz @ -18 dB/oct  
165 - 250 Hz @ 0.2  $g^2/Hz$   
250 - 380 Hz @ -9 dB/oct  
380 - 1000 Hz @ 0.06  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 16.0  $g_{rms}$

#### Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
40 - 44 Hz @ -9 dB/oct  
44 - 1000 Hz @ 0.1  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 12.2  $g_{rms}$

Input to the ET/SRB Range Safety Couplers, Receiver, Decoder (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
 20 - 25 Hz @ +9 dB/oct  
 25 - 40 Hz @ 4.0  $g^2/Hz$   
 40 - 55 Hz @ -18 dB/oct  
 55 - 136 Hz @ 0.6  $g^2/Hz$   
 136 - 146 Hz @ -18 dB/oct  
 146 - 250 Hz @ 0.4  $g^2/Hz$   
 250 - 448 Hz @ -9 dB/oct  
 448 - 1400 Hz @ 0.07  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.034  $g^2/Hz$

Composite = 18.1  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
 40 - 44 Hz @ -9 dB/oct  
 44 - 150 Hz @ 0.10  $g^2/Hz$   
 150 - 300 Hz @ +3 dB/oct  
 300 - 800 Hz @ 0.20  $g^2/Hz$   
 800 - 855 Hz @ +15 dB/oct  
 855 - 1100 Hz @ 0.28  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.085  $g^2/Hz$

Composite = 18.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.38  $g^2/Hz$   
 20 - 70 Hz @ +3 dB/oct  
 70 - 90 Hz @ 1.20  $g^2/Hz$   
 90 - 115 Hz @ -12 dB/oct  
 115 - 250 Hz @ 0.44  $g^2/Hz$   
 250 - 550 Hz @ -12 dB/oct  
 550 - 1000 Hz @ 0.020  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0050  $g^2/Hz$

Composite = 13.9  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.54  $g^2/Hz$   
 20 - 34 Hz @ +3 dB/oct  
 34 - 50 Hz @ 0.90  $g^2/Hz$   
 50 - 80 Hz @ -12 dB/oct  
 80 - 450 Hz @ 0.15  $g^2/Hz$   
 450 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.034  $g^2/Hz$

Composite = 13.8  $g_{rms}$

Input to the ET/SRB Range Safety Couplers, Receivers, Decoder (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical method or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the ET/SRD Range Safety Safe and Arm Device

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.5  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 1.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.15  $g^2/Hz$   
136 - 155 Hz @ -18 dB/oct  
155 - 250 Hz @ 0.070  $g^2/Hz$   
250 - 420 Hz @ -9 dB/oct  
420 - 1000 Hz @ 0.015  $g^2/Hz$   
1000 - 1100 Hz @ -6 dB/oct  
1100 - 1400 Hz @ 0.013  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0063  $g^2/Hz$

Composite = 8.4  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.033  $g^2/Hz$   
40 - 48 Hz @ -9 dB/oct  
48 - 135 Hz @ 0.02  $g^2/Hz$   
135 - 255 Hz @ +3 dB/oct  
255 - 700 Hz @ 0.038  $g^2/Hz$   
700 - 755 Hz @ +15 dB/oct  
755 - 1100 Hz @ 0.055  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.017  $g^2/Hz$

Composite = 8.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 170 Hz @ -18 dB/oct  
170 - 250 Hz @ 0.15  $g^2/Hz$   
250 - 340 Hz @ -9 dB/oct  
340 - 1000 Hz @ 0.06  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 15.8  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
40 - 48 Hz @ -9 dB/oct  
48 - 1000 Hz @ 0.08  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.02  $g^2/Hz$

Composite = 10.9  $g_{rms}$



Input to the ET/SRB Range Safety Safe and Arm Device (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 155 Hz @ -18 dB/oct  
155 - 250 Hz @ 0.28  $g^2/Hz$   
250 - 420 Hz @ -9 dB/oct  
420 - 1000 Hz @ 0.06  $g^2/Hz$   
1000 - 1100 Hz @ -6 dB/oct  
1100 - 1400 Hz @ 0.05  $g^2/Hz$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025  $g^2/Hz$

Composite = 16.7  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
40 - 48 Hz @ -9 dB/oct  
48 - 135 Hz @ 0.08  $g^2/Hz$   
135 - 255 Hz @ +3 dB/oct  
255 - 700 Hz @ 0.15  $g^2/Hz$   
700 - 755 Hz @ +15 dB/oct  
755 - 1100 Hz @ 0.22  $g^2/Hz$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.067  $g^2/Hz$

Composite = 16.9  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @ 0.50  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 1.00  $g^2/Hz$   
60 - 75 Hz @ -12 dB/oct  
75 - 230 Hz @ 0.36  $g^2/Hz$   
230 - 500 Hz @ -12 dB/oct  
500 - 1000 Hz @ 0.017  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0042  $g^2/Hz$

Composite = 11.9  $g_{rms}$

Long. and Tang. Axes

20 - 40 Hz @ 0.75  $g^2/Hz$   
40 - 60 Hz @ -12 dB/oct  
60 - 400 Hz @ 0.13  $g^2/Hz$   
400 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.026  $g^2/Hz$

Composite = 12.2  $g_{rms}$

Input to the ET/SRB Range Safety Safe and Arm Device (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 1.7 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

## Input to the ET/SRB NSI Detonator

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @ 0.095  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @ 0.3  $g^2/Hz$   
90 - 97 Hz @ -12 dB/oct  
97 - 130 Hz @ 0.23  $g^2/Hz$   
130 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 0.85  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.038  $g^2/Hz$

Composite = 25.7  $g_{rms}$

#### Long. and Tang. Axes

20 - 145 Hz @ 0.14  $g^2/Hz$   
145 - 180 Hz @ +9 dB/oct  
180 - 540 Hz @ 0.25  $g^2/Hz$   
540 - 810 Hz @ +3 dB/oct  
810 - 1200 Hz @ 0.38  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.14  $g^2/Hz$

Composite = 22.9  $g_{rms}$

### 2. Flight Random Vibration Criteria (4 min plus 2 min/mission/axis)

#### Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 150 Hz @ 0.6  $g^2/Hz$   
150 - 180 Hz @ +9 dB/oct  
180 - 540 Hz @ 1.0  $g^2/Hz$   
540 - 810 Hz @ +3 dB/oct  
810 - 1200 Hz @ 1.5  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.54  $g^2/Hz$

Composite = 46.7  $g_{rms}$

#### Long. and Tang. Axes

20 - 145 Hz @ 0.54  $g^2/Hz$   
145 - 180 Hz @ +9 dB/oct  
180 - 540 Hz @ 1.00  $g^2/Hz$   
540 - 810 Hz @ +3 dB/oct  
810 - 1200 Hz @ 1.5  $g^2/Hz$   
1200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.54  $g^2/Hz$

Composite = 45.8  $g_{rms}$

Input to the ET/SRB NSI Detonator (Cont.)

3. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 Hz @  $0.38 \text{ g}^2/\text{Hz}$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
90 - 97 Hz @ -12 dB/oct  
97 - 130 Hz @  $0.90 \text{ g}^2/\text{Hz}$   
130 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @  $3.40 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -5 dB/oct  
2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $51.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.54 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +3 dB/oct  
34 - 50 Hz @  $0.90 \text{ g}^2/\text{Hz}$   
50 - 54 Hz @ -12 dB/oct  
54 - 70 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
70 - 120 Hz @ +3 dB/oct  
120 - 1000 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $40.0 \text{ g}_{\text{rms}}$

Input to the ET/SRB NSI Detonator (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 4.3 G's peak

5. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 24 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 94 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 3,750 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

## Input to the ET/SRB CDF Assembly

### 1. Acceptance Test Criteria

#### Radial Axis

20 Hz @ 0.5  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 1.0  $g^2/Hz$   
40 - 48 Hz @ -18 dB/oct  
48 - 80 Hz @ 0.38  $g^2/Hz$   
80 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @ 0.88  $g^2/Hz$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 1.5  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.098  $g^2/Hz$

Composite = 39.9  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.018  $g^2/Hz$   
20 - 150 Hz @ +4 dB/oct  
150 - 300 Hz @ 0.20  $g^2/Hz$   
300 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @ 0.75  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.098  $g^2/Hz$

Composite = 27.5  $g_{rms}$

### 2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

#### Radial Axis

20 Hz @ 2  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 150 Hz @ -18 dB/oct  
150 - 360 Hz @ 0.36  $g^2/Hz$   
360 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @ 1.0  $g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.16  $g^2/Hz$

Composite = 33.1  $g_{rms}$

#### Long. and Tang. Axes

20 - 225 Hz @ 0.140  $g^2/Hz$   
225 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @ 0.5  $g^2/Hz$   
800 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.20  $g^2/Hz$

Composite = 25.6  $g_{rms}$

Input to the ET/SRB CDF Assembly (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission/axis)

Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 48 Hz @ -18 dB/oct  
48 - 80 Hz @ 1.5  $g^2/Hz$   
80 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @ 3.5  $g^2/Hz$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 6.0  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.39  $g^2/Hz$

Composite = 79.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.07  $g^2/Hz$   
20 - 150 Hz @ +4 dB/oct  
150 - 300 Hz @ 0.8  $g^2/Hz$   
300 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @ 3.0  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.39  $g^2/Hz$

Composite = 55.0  $g_{rms}$

4. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission/axis)

Radial Axis

20 - 30 Hz @ 0.80  $g^2/Hz$   
30 - 50 Hz @ +3 dB/oct  
50 - 200 Hz @ 1.30  $g^2/Hz$   
200 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 3.40  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 51.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.80  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 1.60  $g^2/Hz$   
60 - 65 Hz @ -12 dB/oct  
65 - 1000 Hz @ 1.20  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 40.5  $g_{rms}$

Input to the ET/SRB CDF Assembly (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 47 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 188 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 7,500 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only



Input to the ET/SRB CDF Assembly (Cont.)

5. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 47 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 188 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 7,500 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
30 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
20 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the ET/SRB CDF Manifold

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.063  $g^2/\text{Hz}$   
20 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @ 0.88  $g^2/\text{Hz}$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 1.5  $g^2/\text{Hz}$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.096  $g^2/\text{Hz}$

Composite = 38.5  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.014  $g^2/\text{Hz}$   
20 - 150 Hz @ +4 dB/oct  
150 - 360 Hz @ 0.2  $g^2/\text{Hz}$   
360 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @ 0.75  $g^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.096  $g^2/\text{Hz}$

Composite = 27.8  $g_{\text{rms}}$

2. Lift-off Random Vibration Criteria (50 sec plus 10 sec/mission/axis)

Radial Axis

20 Hz @ 0.050  $g^2/\text{Hz}$   
20 - 34 Hz @ +6 dB/oct  
34 - 54 Hz @ 0.15  $g^2/\text{Hz}$   
54 - 100 Hz @ +9 dB/oct  
100 - 170 Hz @ 0.95  $g^2/\text{Hz}$   
170 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.082  $g^2/\text{Hz}$

Composite = 22.2  $g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @ 0.056  $g^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 340 Hz @ 0.14  $g^2/\text{Hz}$   
340 - 400 Hz @ +6 dB/oct  
400 - 1200 Hz @ 0.19  $g^2/\text{Hz}$   
1200 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.11  $g^2/\text{Hz}$

Composite = 17.9  $g_{\text{rms}}$

Input to the ET/SRB CDF Manifold (Cont.)

3. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @ 0.25  $g^2/Hz$   
20 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @ 3.5  $g^2/Hz$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 6.0  $g^2/Hz$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.39  $g^2/Hz$

Composite = 76.9  $g_{rms}$

Long. and Tang. Axis

20 Hz @ 0.054  $g^2/Hz$   
20 - 150 Hz @ +4 dB/oct  
150 - 360 Hz @ 0.8  $g^2/Hz$   
360 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @ 3.0  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.39  $g^2/Hz$

Composite = 55.5  $g_{rms}$

4. Reentry Random Vibration Criteria (30 sec plus 30 sec/mission/axis)

Radial Axis

20 - 30 Hz @ 0.80  $g^2/Hz$   
30 - 50 Hz @ +3 dB/oct  
50 - 200 Hz @ 1.30  $g^2/Hz$   
200 - 500 Hz @ +3 dB/oct  
500 - 700 Hz @ 3.40  $g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 51.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 3.80  $g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 60 Hz @ 1.60  $g^2/Hz$   
60 - 65 Hz @ -12 dB/oct  
65 - 1000 Hz @ 1.20  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 40.5  $g_{rms}$

Input to the ET/SRB CDF Manifold (Cont.)

5 Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

5 - 5 Hz @ 4.3 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 40 Hz @ 4.3 G's peak

6. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 47 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 188 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 7,500 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
3.1 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
7.3 G's peak Amplitude  
300 msec Duration

\* Design Criteria Only

Input to the ET/SRB Range Safety Integrated Receiver/Decoder (IRD)

1 Acceptance Test Criteria (3 min/axis)

Radial Axis

20 Hz @  $1.18 \text{ g}^2/\text{Hz}$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @  $2.37 \text{ g}^2/\text{Hz}$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @  $0.36 \text{ g}^2/\text{Hz}$   
136 - 146 Hz @ -18 dB/oct  
146 - 250 Hz @  $0.24 \text{ g}^2/\text{Hz}$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.02 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 40 Hz @  $0.08 \text{ g}^2/\text{Hz}$   
40 - 44 Hz @ -9 dB/oct  
44 - 150 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $14.5 \text{ g}_{\text{rms}}$

2. Qualification/Acceptance Criteria (7 min/axis)

Radial Axis

20 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @  $4.0 \text{ g}^2/\text{Hz}$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
136 - 146 Hz @ -18 dB/oct  
146 - 250 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.034 \text{ g}^2/\text{Hz}$

Composite =  $18.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 40 Hz @  $0.133 \text{ g}^2/\text{Hz}$   
40 - 44 Hz @ -9 dB/oct  
44 - 150 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $18.9 \text{ g}_{\text{rms}}$

3. Liftoff Random Vibration Criteria (50 sec plus 10 sec/mission in each axis)

Radial Axis

20 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @  $4.0 \text{ g}^2/\text{Hz}$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
136 - 165 Hz @ -18 dB/oct  
165 - 250 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
250 - 380 Hz @ -9 dB/oct  
380 - 1000 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $16.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 40 Hz @  $0.133 \text{ g}^2/\text{Hz}$   
40 - 44 Hz @ -9 dB/oct  
44 - 1000 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ -6 dB/oct

Composite =  $12.2 \text{ g}_{\text{rms}}$

Input to the ET/SRB Range Safety Integrated Receiver/Decoder (IRD) (Cont.)

4. Boost Random Vibration Criteria (80 sec plus 40 sec/mission in each axis)

Radial Axis

20 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @  $4.0 \text{ g}^2/\text{Hz}$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
136 - 146 Hz @ -18 dB/oct  
146 - 250 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
250 - 448 Hz @ -9 dB/oct  
448 - 1400 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.034 \text{ g}^2/\text{Hz}$

Composite =  $18.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 40 Hz @  $0.133 \text{ g}^2/\text{Hz}$   
40 - 44 Hz @ -9 dB/oct  
44 - 150 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
150 - 300 Hz @ +3 dB/oct  
300 - 800 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
800 - 855 Hz @ +15 dB/oct  
855 - 1100 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $18.9 \text{ g}_{\text{rms}}$

5. Reentry Random Vibration Criteria (60 sec plus 30 sec/mission in each axis)

Radial Axis

20 Hz @  $0.38 \text{ g}^2/\text{Hz}$   
20 - 70 Hz @ +3 dB/oct  
70 - 90 Hz @  $1.20 \text{ g}^2/\text{Hz}$   
90 - 115 Hz @ -12 dB/oct  
115 - 250 Hz @  $0.44 \text{ g}^2/\text{Hz}$   
250 - 550 Hz @ -12 dB/oct  
550 - 1000 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.54 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +3 dB/oct  
34 - 50 Hz @  $0.90 \text{ g}^2/\text{Hz}$   
50 - 80 Hz @ -12 dB/oct  
80 - 450 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
450 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.034 \text{ g}^2/\text{Hz}$

Composite =  $13.8 \text{ g}_{\text{rms}}$

6. Random Vibration Test Tolerances

a. Acceptance test criteria: +1 dB, -3 dB

b. Qualification/acceptance and qualification criteria: +3 dB, -1 dB

7. Vehicle Dynamics Criteria

Longitudinal Axis

3.5 - 5 Hz @ 1.0 G's peak\*  
5 - 40 Hz @ 1.0 G's peak

Lateral Axes

2 - 5 Hz @ 1.7 G's peak\*  
5 - 10 Hz @ 0.8 G's peak  
10 - 30 Hz @ 1.7 G's peak

\* Design Criteria Only

Input to the ET/SRB Range Safety Integrated Receiver/Decoder (IRD) (Cont.)

8. Shock Test Criteria

Tests will be performed by applying two shocks per mission in each axis (one in each direction or equivalent) for a total of six shocks per mission by mechanical methods or one shock per mission by ordnance.

A. Ordnance

50 Hz @ 12 G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ 47 G's peak  
100 - 4,000 Hz @ +6 dB/oct  
4,000 - 10,000 Hz @ 1,875 G's peak

B. Water Landing

Longitudinal Axis

Half Sine Pulse  
20 G's peak Amplitude  
150 msec Duration

Lateral Axes

Half Sine Pulse  
22 G's peak Amplitude  
100 msec Duration

C. Parachute Deployment

Longitudinal Axis

Half Sine Pulse  
4.6 G's peak Amplitude  
300 msec Duration

Lateral Axes

Half Sine Pulse  
4.6 G's peak Amplitude  
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PART III

VIBRATION, ACOUSTIC, AND SHOCK

DESIGN AND TEST CRITERIA

FOR

COMPONENTS ON THE LWT

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# SECTION I. EXTERNAL TANK ZONES

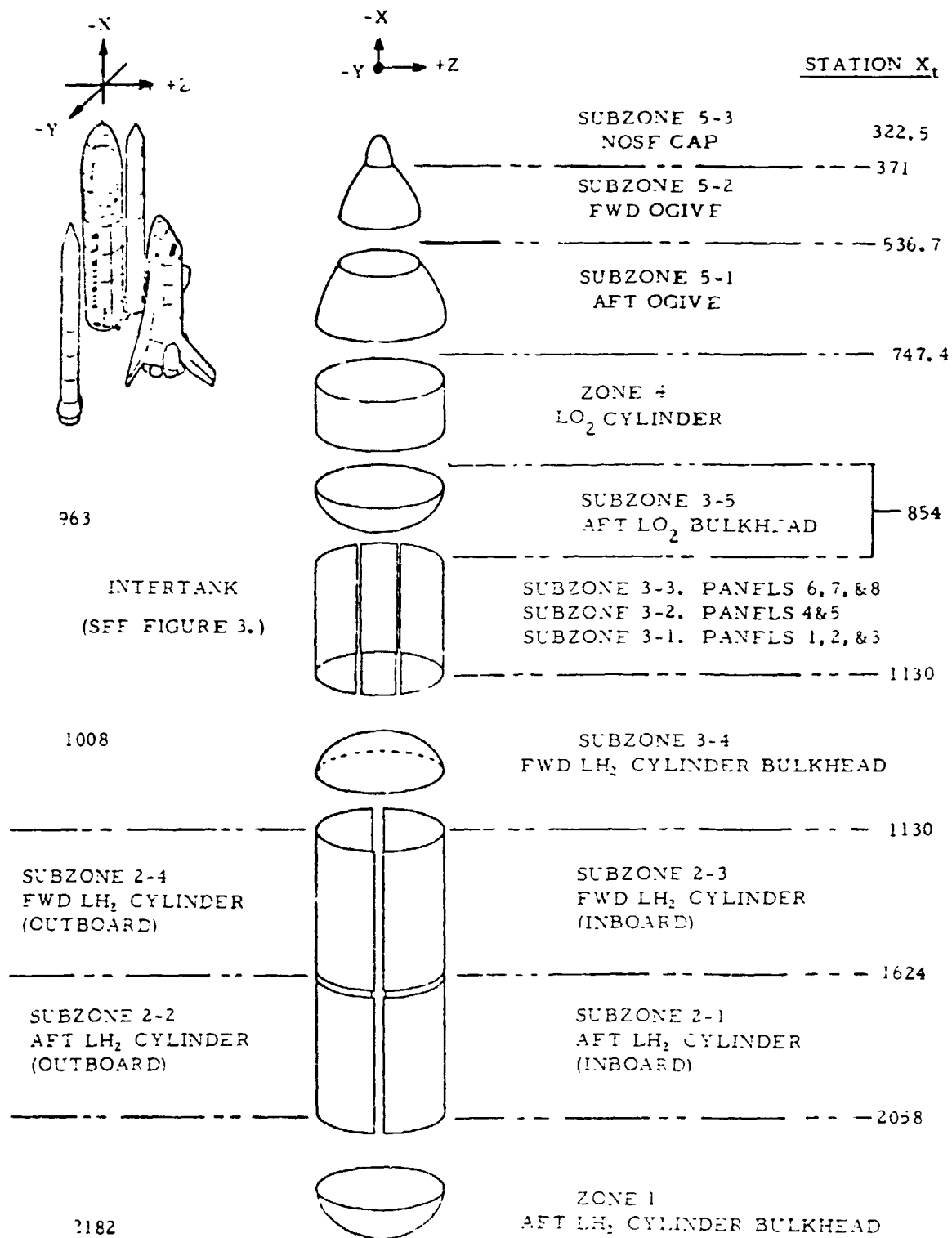


Figure 3-1

## SECTION II. VIBRATION SPECIFICATIONS

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Zo. 1 Et LH<sub>2</sub> Aft Bulkhead

Subzone 1-1 ET LH<sub>2</sub> Aft Bulkhead Gores (General Specifications)

Same as Subzone 1-1 A below.

Subzone 1-1-A Input to Components Mounted on the ET LH<sub>2</sub> Aft Bulkhead Gores. Weight of Component = 8 lbs.

### 1. Acceptance Test Criteria (1 min./axis)

#### Direction A

20 Hz @ 0.019  $g^2/Hz$   
20 - 110 Hz @ +9 dB/oct  
110 - 300 Hz @ 3.12  $g^2/Hz$   
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.47  $g^2/Hz$

Composite = 49.6  $g_{rms}$

#### Directions B and C

20 Hz @ 0.018  $g^2/Hz$   
20 - 130 Hz @ +6 dB/oct  
130 - 340 Hz @ 0.72  $g^2/Hz$   
340 - 430 Hz @ +6 dB/oct  
430 - 3000 Hz @ 1.15  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.58

Composite = 41.5  $g_{rms}$

### 2. Lift off Random Vibration Criteria (1 min./axis)

#### Direction A

20 Hz @ 0.076  $g^2/Hz$   
20 - 110 Hz @ +9 dB/oct  
110 - 300 Hz @ 12.50  $g^2/Hz$   
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 1.89  $g^2/Hz$

Composite = 99.3  $g_{rms}$

#### Directions B and C

20 Hz @ 0.070  $g^2/Hz$   
20 - 130 Hz @ +6 dB/oct  
130 - 340 Hz @ 2.90  $g^2/Hz$   
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 4.60  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 2.30  $g^2/Hz$

Composite = 83.0  $g_{rms}$

## 3. Boost Random Vibration Criteria (2 min/axis)

## Direction A

20 Hz @  $0.37 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 300 Hz @  $9.0 \text{ g}^2/\text{Hz}$   
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $1.4 \text{ g}^2/\text{Hz}$

Composite =  $85.0 \text{ g}_{\text{rms}}$ 

## Directions B and C

20 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +6 dB/oct  
120 - 1000 Hz @  $2.9 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $1.5 \text{ g}^2/\text{Hz}$

Composite =  $68.4 \text{ g}_{\text{rms}}$ 

## 4. Vehicle Dynamics Criteria

## Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

## Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

## 5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only



Subzone 1-1-B Input to Components Mounted on the ET LH<sub>2</sub> Aft  
Bulkhead Gores. Weight of Components  $\geq 8$  but  $< 25$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.019 g<sup>2</sup>/Hz  
20 - 88 Hz @ +9 dB/oct  
88 - 300 Hz @ 1.56 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.24 g<sup>2</sup>/Hz

Composite = 35.4 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.018 g<sup>2</sup>/Hz  
20 - 92 Hz @ +6 dB/oct  
92 - 340 Hz @ 0.36 g<sup>2</sup>/Hz  
340 - 430 Hz @ -3 dB/oct  
430 - 1000 Hz @ 0.58 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.29 g<sup>2</sup>/Hz

Composite = 29.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.076 g<sup>2</sup>/Hz  
20 - 88 Hz @ +9 dB/oct  
88 - 300 Hz @ 1.25 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.94 g<sup>2</sup>/Hz

Composite = 70.9 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.070 g<sup>2</sup>/Hz  
20 - 92 Hz @ +6 dB/oct  
92 - 340 Hz @ 1.45 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 2.30 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 1.15 g<sup>2</sup>/Hz

Composite = 59.1 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.37 g<sup>2</sup>/Hz  
20 - 72 Hz @ +6 dB/oct  
72 - 300 Hz @ 4.5 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.7 g<sup>2</sup>/Hz

Composite = 60.8 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.088 g<sup>2</sup>/Hz  
20 - 88 Hz @ +6 dB/oct  
88 - 1000 Hz @ 1.5 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.75 g<sup>2</sup>/Hz

Composite = 49.5 g<sub>rms</sub>

1-1-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 1-1-C Input to Components Mounted on the ET LH<sub>2</sub> Aft  
Bulkhead Gores. Weight of Component > 25 but < 75 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.019 g<sup>2</sup>/Hz  
20 - 70 Hz @ +9 dB/oct  
70 - 300 Hz @ 0.78 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 25.2 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.018 g<sup>2</sup>/Hz  
20 - 65 Hz @ +6 dB/oct  
65 - 340 Hz @ 0.18 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 0.29 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.14 g<sup>2</sup>/Hz

Composite = 20.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.076 g<sup>2</sup>/Hz  
20 - 70 Hz @ +9 dB/oct  
70 - 300 Hz @ 3.10 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.47 g<sup>2</sup>/Hz

Composite = 50.4 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.070 g<sup>2</sup>/Hz  
20 - 65 Hz @ +6 dB/oct  
65 - 340 Hz @ 0.73 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 1.15 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.58 g<sup>2</sup>/Hz

Composite = 41.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.37 g<sup>2</sup>/Hz  
20 - 49 Hz @ +6 dB/oct  
49 - 300 Hz @ 2.2 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.35 g<sup>2</sup>/Hz

Composite = 42.9 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.088 g<sup>2</sup>/Hz  
20 - 60 Hz @ +6 dB/oct  
60 - 1000 Hz @ 0.75 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.38 g<sup>2</sup>/Hz

Composite = 35.2 g<sub>rms</sub>

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1-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 1-1-D     Input to LH<sub>2</sub> External Feedline, LH<sub>2</sub> Recirculation Line  
and LH<sub>2</sub> Internal Bellows at the Aft LH<sub>2</sub> Dome Core.

1. Acceptance Tst Criteria (1 min/axis)

Direction A

20 Hz @ 0.045 g<sup>2</sup>/Hz  
20 - 50 Hz @ +4 dB/oct  
50 - 300 Hz @ 0.16 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 11.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.018 g<sup>2</sup>/Hz  
20 - 29 Hz @ +6 dB/oct  
29 - 340 Hz @ 0.038 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 0.058 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.03 g<sup>2</sup>/Hz

Composite = 9.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.076 g<sup>2</sup>/Hz  
20 - 50 Hz @ +9 dB/oct  
50 - 300 Hz @ 0.63 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.095 g<sup>2</sup>/Hz

Composite = 22.9 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.07 g<sup>2</sup>/Hz  
20 - 29 Hz @ +6 dB/oct  
29 - 340 Hz @ 0.15 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 0.23 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 19.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (? min/axis)

Direction A

20 Hz @ 0.2 g<sup>2</sup>/Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 300 Hz @ 0.4 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.062 g<sup>2</sup>/Hz

Composite = 18.4 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.075 g<sup>2</sup>/Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 15.8 g<sub>rms</sub>

1-1-D (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 1-2 ET LH<sub>2</sub> Aft Bulkhead Cap and Covers (General Specifications)

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Same as Subzone 1-2-A below.

Subzone 1-2-A Input to Components Mounted on the ET LH<sub>2</sub> Aft Bulkhead Cap and Manhole Cover Plates. Weight of Component < 56 lbs.

1. Acceptance Test Criteria (1 min/axis)

20 Hz @ 0.0080 g <sup>2</sup> /Hz	20 Hz @ 0.0072 g <sup>2</sup> /Hz
20 - 110 Hz @ +9 dB/oct	20 - 130 Hz @ +6 dB/oct
110 - 300 Hz @ 1.30 g <sup>2</sup> /Hz	130 - 340 Hz @ 0.30 g <sup>2</sup> /Hz
300 - 2000 Hz @ -3 dB/oct	340 - 430 Hz @ +6 dB/oct
2000 Hz @ 0.20 g <sup>2</sup> /Hz	430 - 1000 Hz @ 0.48 g <sup>2</sup> /Hz
	1000 - 2000 Hz @ -3 dB/oct
	2000 Hz @ 0.24 g <sup>2</sup> /Hz

Composite = 32.0 g<sub>rms</sub>

Composite = 26.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/ axis)

Direction A

20 Hz @ 0.032 g <sup>2</sup> /Hz
20 - 110 Hz @ +9 dB/oct
110 - 300 Hz @ 5.20 g <sup>2</sup> /Hz
300 - 2000 Hz @ -3 dB/oct
2000 Hz @ 0.78 g <sup>2</sup> /Hz

Composite = 64.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.029 g <sup>2</sup> /Hz
20 - 130 Hz @ +6 dB/oct
130 - 340 Hz @ 1.20 g <sup>2</sup> /Hz
340 - 430 Hz @ +6 dB/oct
430 - 1000 Hz @ 1.90 g <sup>2</sup> /Hz
1000 - 2000 Hz @ -3 dB/oct
2000 Hz @ 0.95 g <sup>2</sup> /Hz

Composite = 53.3 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.11 g <sup>2</sup> /Hz
20 - 100 Hz @ +6 dB/oct
100 - 200 Hz @ 2.60 g <sup>2</sup> /Hz
200 - 2000 Hz @ -6 dB/oct
2000 Hz @ 0.026 g <sup>2</sup> /Hz

Composite = 28.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.035 g <sup>2</sup> /Hz
20 - 90 Hz @ +6 dB/oct
90 - 150 Hz @ 0.71 g <sup>2</sup> /Hz
150 - 260 Hz @ -9 dB/oct
260 - 1000 Hz @ 0.14 g <sup>2</sup> /Hz
1000 - 2000 Hz @ -6 dB/oct
2000 Hz @ 0.035 g <sup>2</sup> /Hz

Composite = 16.5 g<sub>rms</sub>

1-2-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A -- Perpendicular to Bulkhead

Direction B -- Tangential to Bulkhead

Direction C -- Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only



Subzone 1-2-B Input to Components Mounted on the ET LH<sub>2</sub> Aft Bulk-head Cap and Manhole Cover Plates. Weight of Components  $\geq 50$  but  $< 150$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 - 20 Hz @ 0.0080 g<sup>2</sup>/Hz  
 88 - 88 Hz @ +9 dB/oct  
 38 - 300 Hz @ 0.65 g<sup>2</sup>/Hz  
 300 - 2000 Hz @ -3 dB/oct  
 2000 - 2000 Hz @ 0.098 g<sup>2</sup>/Hz

Composite = 22.6 g<sub>rms</sub>

Directions B and C

20 - 20 Hz @ 0.0072 g<sup>2</sup>/Hz  
 92 - 92 Hz @ +6 dB/oct  
 92 - 340 Hz @ 0.15 g<sup>2</sup>/Hz  
 340 - 430 Hz @ +6 dB/oct  
 430 - 1000 Hz @ 0.24 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 - 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 18.8 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 - 20 Hz @ 0.032 g<sup>2</sup>/Hz  
 88 - 88 Hz @ +9 dB/oct  
 88 - 300 Hz @ 2.60 g<sup>2</sup>/Hz  
 300 - 2000 Hz @ -3 dB/oct  
 2000 - 2000 Hz @ 0.39 g<sup>2</sup>/Hz

Composite = 45.2 g<sub>rms</sub>

Directions B and C

20 - 20 Hz @ 0.029 g<sup>2</sup>/Hz  
 92 - 92 Hz @ +6 dB/oct  
 92 - 340 Hz @ 0.60 g<sup>2</sup>/Hz  
 340 - 430 Hz @ +6 dB/oct  
 430 - 1000 Hz @ 0.95 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 - 2000 Hz @ 0.48 g<sup>2</sup>/Hz

Composite = 37.7 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 - 20 Hz @ 0.11 g<sup>2</sup>/Hz  
 70 - 70 Hz @ +6 dB/oct  
 70 - 200 Hz @ 1.30 g<sup>2</sup>/Hz  
 200 - 2000 Hz @ -6 dB/oct  
 2000 - 2000 Hz @ 0.013 g<sup>2</sup>/Hz

Composite = 20.8 g<sub>rms</sub>

Directions B and C

20 - 20 Hz @ 0.035 g<sup>2</sup>/Hz  
 64 - 64 Hz @ +6 dB/oct  
 64 - 150 Hz @ 0.36 g<sup>2</sup>/Hz  
 150 - 260 Hz @ -9 dB/oct  
 260 - 1000 Hz @ 0.070 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 - 2000 Hz @ 0.018 g<sup>2</sup>/Hz

Composite = 12.0 g<sub>rms</sub>

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**1-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

**See Table I**

**Direction A - Perpendicular to Bulkhead**

**Direction B - Tangential to Bulkhead**

**Direction C - Tangential to Bulkhead, Perpendicular to Direction B**

**\* Design Criteria Only**

1-2-C Input to Components Mounted on the ET LH<sub>2</sub> Aft Bulkhead Cap and Manhole Cover Plates. Weight of Component  $\geq$  150 but < 300 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0080 g<sup>2</sup>/Hz  
20 - 70 Hz @ +9 dB/oct  
70 - 300 Hz @ 0.32 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.050 g<sup>2</sup>/Hz

Composite = 16.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0072 g<sup>2</sup>/Hz  
20 - 65 Hz @ +6 dB/oct  
65 - 340 Hz @ 0.075 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.060 g<sup>2</sup>/Hz

Composite = 13.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.032 g<sup>2</sup>/Hz  
20 - 70 Hz @ +9 dB/oct  
70 - 300 Hz @ 1.30 g<sup>2</sup>/Hz  
300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.20 g<sup>2</sup>/Hz

Composite = 32.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.029 g<sup>2</sup>/Hz  
20 - 65 Hz @ +6 dB/oct  
65 - 340 Hz @ 0.30 g<sup>2</sup>/Hz  
340 - 430 Hz @ +6 dB/oct  
430 - 1000 Hz @ 0.48 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.24 g<sup>2</sup>/Hz

Composite 27.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.11 g<sup>2</sup>/Hz  
20 - 50 Hz @ +6 dB/oct  
50 - 200 Hz @ 0.65 g<sup>2</sup>/Hz  
200 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0066 g<sup>2</sup>/Hz

Composite = 15.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.035 g<sup>2</sup>/Hz  
20 - 45 Hz @ +6 dB/oct  
45 - 150 Hz @ 0.18 g<sup>2</sup>/Hz  
150 - 260 Hz @ -9 dB/oct  
260 - 1000 Hz @ 0.035 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0088 g<sup>2</sup>/Hz

Composite = 8.6 g<sub>rms</sub>

**1-2-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

**Direction A — Perpendicular to Bulkhead**

**Direction B — Tangential to Bulkhead**

**Direction C — Tangential to Bulkhead, Perpendicular to Direction B**

**\* Design Criteria Only**

Subzone 1-2-D Input to the LH<sub>2</sub> Siphon on the ET LH<sub>2</sub> Aft Bulkhead  
 Cap. Component wt = 320#.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0080 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 300 Hz @ 0.18 g<sup>2</sup>/Hz  
 300 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.027 g<sup>2</sup>/Hz

Composite = 12.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0072 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +6 dB/oct  
 48 - 340 Hz @ 0.040 g<sup>2</sup>/Hz  
 340 - 430 Hz @ +6 dB/oct  
 430 - 1000 Hz @ 0.065 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.032 g<sup>2</sup>/Hz

Composite = 10.0 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.032 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 300 Hz @ 0.70 g<sup>2</sup>/Hz  
 300 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.11 g<sup>2</sup>/Hz

Composite = 24.1 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.029 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +6 dB/oct  
 48 - 340 Hz @ 0.16 g<sup>2</sup>/Hz  
 340 - 430 Hz @ +6 dB/oct  
 430 - 1000 Hz @ 0.26 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite 20.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.11 g<sup>2</sup>/Hz  
 20 - 36 Hz @ +6 dB/oct  
 36 - 200 Hz @ 0.35 g<sup>2</sup>/Hz  
 200 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0036 g<sup>2</sup>/Hz

Composite = 11.1 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.035 g<sup>2</sup>/Hz  
 20 - 33 Hz @ +6 dB/oct  
 33 - 150 Hz @ 0.096 g<sup>2</sup>/Hz  
 150 - 260 Hz @ -9 dB/oct  
 260 - 1000 Hz @ 0.019 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0048 g<sup>2</sup>/Hz

Composite = 6.4 g<sub>rms</sub>

**1-2-D (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction B — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Zone 2 ET LH<sub>2</sub> Cylinder

Subzone 2-1 ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>t</sub> 2058 to X<sub>t</sub> 1624), Inboard Half (+Z Axis ±90°). (General Specifications)

Same as Subzone 2-1-1-A below.

Subzone 2-1-1 Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>t</sub> 2058 to X<sub>t</sub> 1624), Inboard Half (+Z Axis ±90°). (General Specifications).

Same as Subzone 2-1-1-A below.

Subzone 2-1-1-A Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>t</sub> 2058 to X<sub>t</sub> 1624), Inboard Half (+Z ±90°), and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray installation. Weight of component < 15 lb.

# 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 - 20 Hz @ 0.045 g<sup>2</sup>/Hz  
30 - 30 Hz @ +6 dB/oct  
30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
56 - 100 Hz @ +12 dB/oct  
100 - 400 Hz @ 1.0 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 28.7 g<sub>rms</sub>

## Long. and Tang. Axes

20 - 20 Hz @ 0.011 g<sup>2</sup>/Hz  
130 - 130 Hz @ +4 dB/oct  
130 - 700 Hz @ 0.13 g<sup>2</sup>/Hz  
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 13.1 g<sub>rms</sub>

# 2. Lift-off Random Vibration Criteria (1 min/axis)

## Radial Axis

20 - 20 Hz @ 0.067 g<sup>2</sup>/Hz  
30 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
47 - 90 Hz @ +12 dB/oct  
90 - 400 Hz @ 2.0 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 41.1 g<sub>rms</sub>

## Long. and Tang. Axes

20 - 20 Hz @ 0.00084 g<sup>2</sup>/Hz  
100 - 100 Hz @ +9 dB/oct  
100 - 400 Hz @ 0.10 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.30 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 19.7 g<sub>rms</sub>

2-1-1-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.18  $g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 56 Hz @ 0.4  $g^2/Hz$   
56 - 100 Hz @ +12 dB/oct  
100 - 400 Hz @ 4.0  $g^2/Hz$   
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.47  $g^2/Hz$

Composite = 57.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.042  $g^2/Hz$   
20 - 130 Hz @ +4 dB/oct  
130 - 700 Hz @ 0.5  $g^2/Hz$   
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.18  $g^2/Hz$

Composite = 26.1  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



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Subzone 2-1-1-B Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Inboard Half (+Z ±90°), and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray installation. Weight of Component ≥ 15 but < 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.045 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
56 - 34 Hz @ +12 dB/oct  
84 - 400 Hz @ 0.50 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.058 g<sup>2</sup>/Hz

Composite = 20.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.011 g<sup>2</sup>/Hz  
20 - 78 Hz @ +4 dB/oct  
78 - 700 Hz @ 0.063 g<sup>2</sup>/Hz  
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.022 g<sup>2</sup>/Hz

Composite = 9.3 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
47 - 76 Hz @ +12 dB/oct  
76 - 400 Hz @ 1.0 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 28.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
20 - 78 Hz @ +9 dB/oct  
78 - 400 Hz @ 0.050 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 14.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.18 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 56 Hz @ 0.4 g<sup>2</sup>/Hz  
56 - 84 Hz @ +12 dB/oct  
84 - 400 Hz @ 2.0 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 41.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.042 g<sup>2</sup>/Hz  
20 - 78 Hz @ +4 dB/oct  
78 - 700 Hz @ 0.25 g<sup>2</sup>/Hz  
700 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.086 g<sup>2</sup>/Hz

Composite = 18.6 g<sub>rms</sub>

2-1-1-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-1-C Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Inboard Half (+Z ±90°), and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray installation. Weight of Component ≥ 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.045 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
 56 - 71 Hz @ +12 dB/oct  
 71 - 400 Hz @ 0.25 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.03 g<sup>2</sup>/Hz

Composite = 14.5 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.011 g<sup>2</sup>/Hz  
 44 - 44 Hz @ +4 dB/oct  
 44 - 700 Hz @ 0.03 g<sup>2</sup>/Hz  
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 6.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.067 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
 47 - 64 Hz @ +12 dB/oct  
 64 - 400 Hz @ 0.5 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.06 g<sup>2</sup>/Hz

Composite = 20.5 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.00084 g<sup>2</sup>/Hz  
 62 - 62 Hz @ +9 dB/oct  
 62 - 400 Hz @ 0.025 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @ 0.18 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.4 g<sup>2</sup>/Hz  
 56 - 71 Hz @ +12 dB/oct  
 71 - 400 Hz @ 1.0 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 28.9 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.042 g<sup>2</sup>/Hz  
 44 - 44 Hz @ +4 dB/oct  
 44 - 700 Hz @ 0.12 g<sup>2</sup>/Hz  
 700 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.041 g<sup>2</sup>/Hz

Composite = 13.0 g<sub>rms</sub>

2-1-1-C (Cont'd)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-1-AP Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2058 - X<sub>T</sub> 1624), Inboard Half (+Z = and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 15 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.045 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
 56 - 100 Hz @ +12 dB/oct  
 100 - 400 Hz @ 1.0 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 28.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0093 g<sup>2</sup>/Hz  
 20 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @ 0.2 g<sup>2</sup>/Hz  
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @ 0.125 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 13.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
 47 - 90 Hz @ +12 dB/oct  
 90 - 400 Hz @ 2.0 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 41.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +9 dB/oct  
 100 - 400 Hz @ 0.10 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.30 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 19.7 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.18 g<sup>2</sup>/Hz  
 20 - 30 Hz @ -6 dB/oct  
 30 - 56 Hz @ 0.4 g<sup>2</sup>/Hz  
 56 - 100 Hz @ +12 dB/oct  
 100 - 400 Hz @ 4.0 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.47 g<sup>2</sup>/Hz

Composite = 57.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.037 g<sup>2</sup>/Hz  
 20 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @ 0.8 g<sup>2</sup>/Hz  
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @ 0.5 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 27.7 g<sub>rms</sub>

**2-1-1-AP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-1-1-BP Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Inboard Half (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray installation. Weight of Component : 15 but - 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.045 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
 56 - 84 Hz @ +12 dB/oct  
 84 - 400 Hz @ 0.50 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.058 g<sup>2</sup>/Hz

Composite = 20.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0093 g<sup>2</sup>/Hz  
 20 - 84 Hz @ +4 dB/oct  
 84 - 140 Hz @ 0.063 g<sup>2</sup>/Hz  
 140 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @ 0.1 g<sup>2</sup>/Hz  
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @ 0.063 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
 47 - 76 Hz @ +12 dB/oct  
 76 - 400 Hz @ 1.0 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 28.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
 20 - 78 Hz @ +9 dB/oct  
 78 - 400 Hz @ 0.050 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 14.0 g<sub>rms</sub>

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## 2-1-1-BP (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

	20 Hz @ 0.18 $g^2/Hz$
20 -	30 Hz @ +6 dB/oct
30 -	56 Hz @ 0.4 $g^2/Hz$
56 -	84 Hz @ +12 dB/oct
84 -	400 Hz @ 2.0 $g^2/Hz$
400 -	2000 Hz @ -4 dB/oct
	2000 Hz @ 0.23 $g^2/Hz$

Composite = 41.3  $g_{rms}$

#### Long. and Tang. Axes

	20 Hz @ 0.037 $g^2/Hz$
20 -	84 Hz @ +4 dB/oct
84 -	140 Hz @ 0.25 $g^2/Hz$
140 -	200 Hz @ +4 dB/oct
200 -	250 Hz @ 0.4 $g^2/Hz$
250 -	400 Hz @ -3 dB/oct
400 -	800 Hz @ 0.25 $g^2/Hz$
800 -	2000 Hz @ -3 dB/oct
	2000 Hz @ 0.1 $g^2/Hz$

Composite = 19.8  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 -	5 Hz @ 0.6 G's peak*
5 -	40 Hz @ 0.6 G's peak

#### Lateral Axes

2 -	5 Hz @ 0.8 G's peak*
5 -	40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-1-1-CP Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Inboard Half (+Z ±90°), and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component 45 lb. but < 100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.045 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
 56 - 71 Hz @ +12 dB/oct  
 71 - 400 Hz @ 0.25 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.03 g<sup>2</sup>/Hz

Composite = 14.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0093 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +4 dB/oct  
 48 - 140 Hz @ 0.03 g<sup>2</sup>/Hz  
 140 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @ 0.05 g<sup>2</sup>/Hz  
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @ 0.03 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 7.0 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
 47 - 64 Hz @ +12 dB/oct  
 64 - 400 Hz @ 0.5 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.06 g<sup>2</sup>/Hz

Composite = 20.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
 20 - 32 Hz @ +9 dB/oct  
 62 - 400 Hz @ 0.025 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

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## 2-1-1-CP (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 - 20 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 30 - 30 Hz @ +6 dB/oct  
 36 - 5 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
 56 - 7 Hz @ +12 dB/oct  
 71 - 100 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @  $0.12 \text{ g}^2/\text{Hz}$

Composite =  $28.9 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 20 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
 48 - 48 Hz @ +4 dB/oct  
 48 - 140 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 140 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.044 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
 5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
 5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-1-DP Input to Components mounted on baffles and stiffened skin on the LH<sub>2</sub> Cylinder, Aft Section (X<sub>T</sub> 2958 to X<sub>T</sub> 1624), Inboard Half (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation Weight of Component ≥ 100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.045 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 56 Hz @ 0.10 g<sup>2</sup>/Hz  
 56 - 59 Hz @ +12 dB/oct  
 59 - 400 Hz @ 0.13 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 10.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0093 g<sup>2</sup>/Hz  
 20 - 29 Hz @ +4 dB/oct  
 29 - 140 Hz @ 0.015 g<sup>2</sup>/Hz  
 140 - 200 Hz @ +4 dB/oct  
 200 - 250 Hz @ 0.025 g<sup>2</sup>/Hz  
 250 - 400 Hz @ -3 dB/oct  
 400 - 800 Hz @ 0.015 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0055 g<sup>2</sup>/Hz

Composite = 4.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +6 dB/oct  
 30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
 47 - 54 Hz @ +12 dB/oct  
 54 - 400 Hz @ 0.25 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.03 g<sup>2</sup>/Hz

Composite = 14.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +9 dB/oct  
 50 - 400 Hz @ 0.013 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.038 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 7.0 g<sub>rms</sub>

## 2-1-1-DP (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 - 20 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
30 - 30 Hz @ +6 dB/oct  
30 - 56 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
56 - 59 Hz @ +12 dB/oct  
59 - 400 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.058 \text{ g}^2/\text{Hz}$

Composite =  $21.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 - 20 Hz @  $0.37 \text{ g}^2/\text{Hz}$   
20 - 29 Hz @ +4 dB/oct  
29 - 140 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
140 - 200 Hz @ +4 dB/oct  
200 - 250 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
250 - 400 Hz @ -3 dB/oct  
400 - 800 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.022 \text{ g}^2/\text{Hz}$

Composite =  $9.8 \text{ g}_{\text{rms}}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-2 Structural Ring at Station  $X_T$  1871 in the ET LH<sub>2</sub> Cylinder, Inboard Half (+Z Axis  $\pm 90^\circ$ ). (General Specifications).

Same as Subzone 2-1-2-A below.

Subzone 2-1-2-A Input to Components mounted on the Structural Ring  $X_T$  1871, Inboard side (+Z  $\pm 90^\circ$ ), and not within  $\pm 10^\circ$  of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
Weight of Component < 75 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.014 g<sup>2</sup>/Hz  
20 - 90 Hz @ +4 dB/oct  
90 - 800 Hz @ 0.1 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.018 g<sup>2</sup>/Hz

Composite = 11 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.025 g<sup>2</sup>/Hz  
20 - 200 Hz @ +2 dB/oct  
200 - 1700 Hz @ 0.11 g<sup>2</sup>/Hz  
1700 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.08 g<sup>2</sup>/Hz

Composite = 14.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.023 g<sup>2</sup>/Hz  
20 - 120 Hz @ +4 dB/oct  
120 - 1100 Hz @ 0.25 g<sup>2</sup>/Hz  
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.076 g<sup>2</sup>/Hz

Composite = 19.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.038 g<sup>2</sup>/Hz  
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @ 0.55 g<sup>2</sup>/Hz  
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 27.6 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.056 g<sup>2</sup>/Hz  
20 - 90 Hz @ +4 dB/oct  
90 - 800 Hz @ 0.4 g<sup>2</sup>/Hz  
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.07 g<sup>2</sup>/Hz

Composite = 21.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.1 g<sup>2</sup>/Hz  
20 - 200 Hz @ +2 dB/oct  
200 - 1700 Hz @ 0.45 g<sup>2</sup>/Hz  
1700 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.32 g<sup>2</sup>/Hz

Composite = 29.2 g<sub>rms</sub>

2-1-2-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-2-B Input to Components mounted on the Structural Ring  
 $\bar{X}_T$  1871, Inboard side (+Z +90°), and not within +10°  
 of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component 75 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.014 g<sup>2</sup>/Hz  
 20 - 54 Hz @ +4 dB/oct  
 54 - 800 Hz @ 0.05 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0088 g<sup>2</sup>/Hz

Composite = 7.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 140 Hz @ +2 dB/oct  
 140 - 1700 Hz @ 0.055 g<sup>2</sup>/Hz  
 1700 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.04 g<sup>2</sup>/Hz

Composite = 10.2 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.015 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +4 dB/oct  
 100 - 1100 Hz @ 0.13 g<sup>2</sup>/Hz  
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.039 g<sup>2</sup>/Hz

Composite = 14.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.020 g<sup>2</sup>/Hz  
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.28 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 19.7 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.056 g<sup>2</sup>/Hz  
 20 - 54 Hz @ +4 dB/oct  
 54 - 800 Hz @ 0.2 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.035 g<sup>2</sup>/Hz

Composite = 15.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.064 g<sup>2</sup>/Hz  
 20 - 140 Hz @ +2 dB/oct  
 140 - 1700 Hz @ 0.22 g<sup>2</sup>/Hz  
 1700 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.16 g<sup>2</sup>/Hz

Composite = 20.4 g<sub>rms</sub>

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2-1-2-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-1-2-AP Input to components mounted on the structural ring (X<sub>T</sub> 1871), Inboard side (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 75 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.014 g<sup>2</sup>/Hz  
 20 - 180 Hz @ +4 dB/oct  
 180 - 300 Hz @ 0.23 g<sup>2</sup>/Hz  
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.13 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.033 g<sup>2</sup>/Hz

Composite = 13.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.033 g<sup>2</sup>/Hz  
 20 - 300 Hz @ +2 dB/oct  
 300 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite = 18.1 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.023 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +4 dB/oct  
 120 - 1100 Hz @ 0.25 g<sup>2</sup>/Hz  
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.076 g<sup>2</sup>/Hz

Composite = 19.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.038 g<sup>2</sup>/Hz  
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.55 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 27.6 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.054 g<sup>2</sup>/Hz  
 20 - 180 Hz @ +4 dB/oct  
 180 - 300 Hz @ 0.9 g<sup>2</sup>/Hz  
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.5 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite = 27.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.13 g<sup>2</sup>/Hz  
 20 - 300 Hz @ +2 dB/oct  
 300 - 1000 Hz @ 0.8 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.5 g<sup>2</sup>/Hz

Composite = 36.1 g<sub>rms</sub>

2-1-2-AP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axis

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-1-2 BP Input to components mounted on the structural ring  
 ( $X_T$  1871), Inboard side (+Z  $\pm 90^\circ$ ) and within  $\pm 10^\circ$   
 of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component  $\geq 75$  lb. but  $< 225$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.01  $g^2/Hz$   
 20 - 130 Hz @ +4 dB/oct  
 130 - 300 Hz @ 0.11  $g^2/Hz$   
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.06  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.016  $g^2/Hz$

Composite = 10.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.022  $g^2/Hz$   
 20 - 210 Hz @ +2 dB/oct  
 210 - 1000 Hz @ 0.1  $g^2/Hz$   
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.033  $g^2/Hz$

Composite = 12.9  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 1100 Hz @ 0.13  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.039  $g^2/Hz$

Composite = 14.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.020  $g^2/Hz$   
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.28  $g^2/Hz$   
 1500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.12  $g^2/Hz$

Composite = 19.7  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.041  $g^2/Hz$   
 20 - 130 Hz @ +4 dB/oct  
 130 - 300 Hz @ 0.45  $g^2/Hz$   
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.25  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.063  $g^2/Hz$

Composite = 20.4  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.088  $g^2/Hz$   
 20 - 210 Hz @ +2 dB/oct  
 210 - 1000 Hz @ 0.4  $g^2/Hz$   
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.13  $g^2/Hz$

Composite = 25.8  $g_{rms}$

**2-1-2-BP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-1-2-CP Input to components mounted on the structural Ring  
 ( $X_T$  1871), inboard side (+Z  $\pm 90^\circ$ ) and within  $\pm 10^\circ$   
of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
Weight of Component  $\geq 225$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.008  $g^2/Hz$   
 20 - 90 Hz @ +4 dB/oct  
 90 - 300 Hz @ 0.055  $g^2/Hz$   
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.03  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0075  $g^2/Hz$

Composite = 7.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.014  $g^2/Hz$   
 20 - 150 Hz @ +2 dB/oct  
 150 - 1000 Hz @ 0.05  $g^2/Hz$   
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.033  $g^2/Hz$

Composite = 9.6  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.023  $g^2/Hz$   
 20 - 80 Hz @ +4 dB/oct  
 80 - 1100 Hz @ 0.065  $g^2/Hz$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.019  $g^2/Hz$

Composite = 10.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.016  $g^2/Hz$   
 20 - 550 Hz @ +2 dB/oct  
 550 - 1500 Hz @ 0.14  $g^2/Hz$   
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.060  $g^2/Hz$

Composite = 15.0  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.031  $g^2/Hz$   
 20 - 90 Hz @ +4 dB/oct  
 90 - 300 Hz @ 0.22  $g^2/Hz$   
 300 - 350 Hz @ -12 dB/oct  
 350 - 1000 Hz @ 0.12  $g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.030  $g^2/Hz$

Composite = 14.2  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.054  $g^2/Hz$   
 20 - 150 Hz @ +2 dB/oct  
 150 - 1000 Hz @ 0.2  $g^2/Hz$   
 1000 - 2000 Hz @ -2 dB/oct  
 2000 Hz @ 0.13  $g^2/Hz$

Composite = 19.2  $g_{rms}$

**2-1-2-CP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-1-3      Structural Ring at Station  $X_T$  2058 in the ET LH<sub>2</sub> Cylinder, Inboard Half (+Z Axis  $\pm 90^\circ$ ). (General Specifications)

Same as Subzone 2-1-3-A below.

Subzone 2-1-3-A      Input to components mounted on the structural Ring at  $X_T$  2058, Inboard side (+Z  $\pm 90^\circ$ ) and not within  $\pm 10^\circ$  of GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.011 g<sup>2</sup>/Hz  
 90 - 90 Hz @ +4 dB/oct  
 90 - 170 Hz @ 0.075 g<sup>2</sup>/Hz  
 170 - 340 Hz @ -3 dB/oct  
 340 - 1000 Hz @ 0.038 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -4 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 8.1 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.014 g<sup>2</sup>/Hz  
 20 - 200 Hz @ +2 dB/oct  
 200 - 1300 Hz @ 0.055 g<sup>2</sup>/Hz  
 1300 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.035 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.012 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +4 dB/oct  
 120 - 1100 Hz @ 0.13 g<sup>2</sup>/Hz  
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.039 g<sup>2</sup>/Hz

Composite = 14.1 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.019 g<sup>2</sup>/Hz  
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.27 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.11 g<sup>2</sup>/Hz

Composite = 19.4 g<sub>rms</sub>

2-1-3-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.044 \text{ g}^2/\text{Hz}$   
20 - 90 Hz @ +4 dB/oct  
90 - 170 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
170 - 340 Hz @ -3 dB/oct  
340 - 1000 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.06 \text{ g}^2/\text{Hz}$

Composite =  $16.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.054 \text{ g}^2/\text{Hz}$   
20 - 200 Hz @ +2 dB/oct  
200 - 1300 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
1300 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.14 \text{ g}^2/\text{Hz}$

Composite =  $19.8 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-i-3-B Input to components mounted on the structural Ring  
at  $X_T$  2058, Inboard side (+Z  $\pm 90^\circ$ ) and not within  
 $\pm 10^\circ$  of GO<sub>2</sub> Press. Line/Cable Tray Installation.  
Weight of Component  $\geq 100$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0083  $g^2$ /Hz  
20 - 65 Hz @ +4 dB/oct  
65 - 170 Hz @ 0.038  $g^2$ /Hz  
170 - 340 Hz @ -3 dB/oct  
340 - 1000 Hz @ 0.019  $g^2$ /Hz  
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.0075  $g^2$ /Hz

Composite = 5.8  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0085  $g^2$ /Hz  
20 - 140 Hz @ +2 dB/oct  
140 - 1300 Hz @ 0.028  $g^2$ /Hz  
1300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.018  $g^2$ /Hz

Composite = 7.1  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0077  $g^2$ /Hz  
20 - 100 Hz @ +4 dB/oct  
100 - 1100 Hz @ 0.065  $g^2$ /Hz  
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.020  $g^2$ /Hz

Composite = 10.0  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0098  $g^2$ /Hz  
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @ 0.14  $g^2$ /Hz  
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.059  $g^2$ /Hz

Composite = 13.9  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.033  $g^2$ /Hz  
20 - 65 Hz @ +4 dB/oct  
65 - 170 Hz @ 0.15  $g^2$ /Hz  
170 - 340 Hz @ -3 dB/oct  
340 - 1000 Hz @ 0.075  $g^2$ /Hz  
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.03  $g^2$ /Hz

Composite = 11.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.034  $g^2$ /Hz  
20 - 140 Hz @ +2 dB/oct  
140 - 1300 Hz @ 0.11  $g^2$ /Hz  
1300 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.072  $g^2$ /Hz

Composite = 14.1  $g_{rms}$

**2-1-3-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-1-3-AP Input to Components mounted on the Structural Ring  
at X<sub>T</sub> 2058, Inboard side (+Z ±90°), and within ±10°  
of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component < 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0088 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +4 dB/oct  
 150 - 200 Hz @ 0.15 g<sup>2</sup>/Hz  
 200 - 500 Hz @ -3 dB/oct  
 500 - 1000 Hz @ 0.05 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 8.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 300 Hz @ +2 dB/oct  
 300 - 1000 Hz @ 0.1 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 12.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.012 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +4 dB/oct  
 120 - 1100 Hz @ 0.13 g<sup>2</sup>/Hz  
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.039 g<sup>2</sup>/Hz

Composite = 14.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.019 g<sup>2</sup>/Hz  
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.27 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.11 g<sup>2</sup>/Hz

Composite = 19.4 g<sub>rms</sub>

3. Boost Random Vibrations Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.035 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +4 dB/oct  
 150 - 200 Hz @ 0.5 g<sup>2</sup>/Hz  
 200 - 500 Hz @ -3 dB/oct  
 500 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.1 g<sup>2</sup>/Hz

Composite = 17.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.064 g<sup>2</sup>/Hz  
 20 - 300 Hz @ +2 dB/oct  
 300 - 1000 Hz @ 0.4 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 25.1 g<sub>rms</sub>

**2-1-3-AP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-1-3-BP Input to Components mounted on the structural Ring at X<sub>T</sub> 2058, Inboard side (+Z ±90°), and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component ≥ 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0068 g<sup>2</sup>/Hz  
 20 - 110 Hz @ +4 dB/oct  
 110 - 200 Hz @ 0.063 g<sup>2</sup>/Hz  
 200 - 500 Hz @ -3 dB/oct  
 500 - 1000 Hz @ 0.024 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 6.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.01 g<sup>2</sup>/Hz  
 20 - 210 Hz @ +2 dB/oct  
 210 - 1000 Hz @ 0.05 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 9.0 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0077 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +4 dB/oct  
 100 - 1100 Hz @ 0.065 g<sup>2</sup>/Hz  
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.020 g<sup>2</sup>/Hz

Composite = 10.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0098 g<sup>2</sup>/Hz  
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @ 0.14 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.059 g<sup>2</sup>/Hz

Composite = 13.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.027 g<sup>2</sup>/Hz  
 20 - 110 Hz @ +4 dB/oct  
 110 - 200 Hz @ 0.25 g<sup>2</sup>/Hz  
 200 - 500 Hz @ -3 dB/oct  
 500 - 1000 Hz @ 0.096 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.048 g<sup>2</sup>/Hz

Composite = 12.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.041 g<sup>2</sup>/Hz  
 20 - 210 Hz @ +2 dB/oct  
 210 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.1 g<sup>2</sup>/Hz

Composite = 17.9 g<sub>rms</sub>

**2-1-3-BP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-2 ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Outboard Half (-Z Axis ±90°). (General Specifications).

Same as Subzone 2-2-1-A below.

Subzone 2-2-1 Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Outboard Half (-Z Axis ±90°). (General Specifications)

Same as Subzone 2-2-1-A below.

Subzone 2-2-1-A Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Outboard Half (-Z Axis ±90°).  
Weight of Component < 15 lbs.

# 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.017 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.038 g<sup>2</sup>/Hz  
47 - 90 Hz @ +12 dB/oct  
90 - 400 Hz @ 0.5 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.058 g<sup>2</sup>/Hz

Composite = 20.6 g<sub>rms</sub>

## Long. and Tang. Axes

20 Hz @ 0.00021 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 400 Hz @ 0.025 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 9.8 g<sub>rms</sub>

# 2. Lift-off Random Vibration Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
47 - 90 Hz @ +12 dB/oct  
90 - 400 Hz @ 2.0 g<sup>2</sup>/Hz  
400 - 2000 Hz @ 4 dB/oct  
2000 Hz @ 0.23 g<sup>2</sup>/Hz

Composite = 41.1 g<sub>rms</sub>

## Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 400 Hz @ 0.10 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.30 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 19.7 g<sub>rms</sub>

2-2-1-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.050  $g^2/Hz$   
20 - 70 Hz @ +6 dB/oct  
70 - 1000 Hz @ 0.60  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.075  $g^2/Hz$

Composite = 28.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0014  $g^2/Hz$   
20 - 100 Hz @ +6 dB/oct  
100 - 1000 Hz @ 0.035  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.018  $g^2/Hz$

Composite = 7.5  $g_{rms}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-2-1-B Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 2058 to X<sub>T</sub> 1624), Outboard Half (-Z Axis  $\pm 90^\circ$ ).  
Weight of Component  $\geq 15$  but  $< 45$  lbs

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
30 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
47 - 76 Hz @ +12 dB/oct  
76 - 400 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $14.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.00021 \text{ g}^2/\text{Hz}$   
78 - 78 Hz @ +9 dB/oct  
78 - 400 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $7.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.067 \text{ g}^2/\text{Hz}$   
30 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
47 - 76 Hz @ +12 dB/oct  
76 - 400 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.12 \text{ g}^2/\text{Hz}$

Composite =  $28.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.00084 \text{ g}^2/\text{Hz}$   
78 - 78 Hz @ +9 dB/oct  
78 - 400 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $14.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
50 - 50 Hz @ +6 dB/oct  
50 - 1000 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $20.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0014 \text{ g}^2/\text{Hz}$   
72 - 72 Hz @ +6 dB/oct  
72 - 1000 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.009 \text{ g}^2/\text{Hz}$

Composite =  $5.4 \text{ g}_{\text{rms}}$

2-2-1-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-2-1-C Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 2058 to X<sub>T</sub> 1624). Outboard Half (-Z Axis  $\pm 90^\circ$ ).  
Weight of Component  $\geq$  45 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.017 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.038 g<sup>2</sup>/Hz  
47 - 64 Hz @ +12 dB/oct  
64 - 400 Hz @ 0.13 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 5.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00021 g<sup>2</sup>/Hz  
20 - 62 Hz @ +9 dB/oct  
62 - 400 Hz @ 0.0062 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.019 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0095 g<sup>2</sup>/Hz

Composite = 4.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.067 g<sup>2</sup>/Hz  
20 - 30 Hz @ +6 dB/oct  
30 - 47 Hz @ 0.15 g<sup>2</sup>/Hz  
47 - 64 Hz @ +12 dB/oct  
64 - 400 Hz @ 0.5 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.06 g<sup>2</sup>/Hz

Composite = 20.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00084 g<sup>2</sup>/Hz  
20 - 62 Hz @ +9 dB/oct  
62 - 400 Hz @ 0.025 g<sup>2</sup>/Hz  
400 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.024 g<sup>2</sup>/Hz  
20 - 50 Hz @ +6 dB/oct  
50 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 14.2 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0014 g<sup>2</sup>/Hz  
20 - 72 Hz @ +6 dB/oct  
72 - 1000 Hz @ 0.015 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0076 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

**2-2-1-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-2-2      Structural Ring at Station  $X_T$  1871 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). (General Specifications)

Same as Subzone 2-2-2-A below.

Subzone 2-2-2-A    Input to Components Mounted on the Structural Ring at Station  $X_T$  1871 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component < 60 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 120 Hz @ +4 dB/oct  
 120 - 1100 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $11.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $15.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 20 - 120 Hz @ +4 dB/oct  
 120 - 1100 Hz @  $0.32 \text{ g}^2/\text{Hz}$   
 1100 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.097 \text{ g}^2/\text{Hz}$

Composite =  $22.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.049 \text{ g}^2/\text{Hz}$   
 20 - 1100 Hz @ +2 dB/oct  
 1100 - 1500 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.30 \text{ g}^2/\text{Hz}$

Composite =  $31.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.017 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +4 dB/oct  
 80 - 200 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 200 - 300 Hz @ -10 dB/oct  
 300 - 1500 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.017 \text{ g}^2/\text{Hz}$

Composite =  $8.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 600 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
 600 - 1000 Hz @ +3 dB/oct  
 1000 - 1500 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.042 \text{ g}^2/\text{Hz}$

Composite =  $10.7 \text{ g}_{\text{rms}}$

**2-2-2-A (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

**Subzone 2-2-2-B** Input to Components Mounted on the Structural Ring  
at Station X<sub>T</sub> 1871 in the ET LH<sub>2</sub> Cylinder, Outboard  
Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component  $\geq 60$  lbs.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @  $0.0047 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +4 dB/oct  
100 - 1100 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $7.8 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.0060 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.087 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.037 \text{ g}^2/\text{Hz}$

Composite =  $11.0 \text{ g}_{\text{rms}}$

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +4 dB/oct  
100 - 1100 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.049 \text{ g}^2/\text{Hz}$

Composite =  $15.7 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $22.0 \text{ g}_{\text{rms}}$

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @  $0.0087 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +4 dB/oct  
80 - 200 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ -10 dB/oct  
300 - 1500 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0085 \text{ g}^2/\text{Hz}$

Composite =  $5.9 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 600 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
600 - 1000 Hz @ +3 dB/oct  
1000 - 1500 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.021 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

**2-2-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 2-2-3 Structural Ring at Station  $X_T$  2058 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). (General Specifications)

Same as Subzone 2-2-3-A below.

Subzone 2-2-3-A Input to Components Mounted on the Structural Ring at Station  $X_T$  2058 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component < 100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0030 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 1100 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.098 \text{ g}^2/\text{Hz}$

Composite =  $7.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0048 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.068 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $9.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 1100 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.039 \text{ g}^2/\text{Hz}$

Composite =  $14.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.27 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $19.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.0073 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +4 dB/oct  
80 - 200 Hz @  $0.046 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ -10 dB/oct  
300 - 1500 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0068 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0093 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 600 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
600 - 1000 Hz @ +3 dB/oct  
1000 - 1500 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.017 \text{ g}^2/\text{Hz}$

Composite =  $6.8 \text{ g}_{\text{rms}}$

2-2-3-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 2-2-3-B Input to Components Mounted on the Structural Ring  
at Station X<sub>T</sub> 2058 in the ET LH<sub>2</sub> Cylinder, Outboard  
Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component  $\geq 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0019 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +4 dB/oct  
100 - 1100 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0077 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +4 dB/oct  
100 - 1100 Hz @  $0.065 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $10.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0098 \text{ g}^2/\text{Hz}$   
20 - 1100 Hz @ +2 dB/oct  
1100 - 1500 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.059 \text{ g}^2/\text{Hz}$

Composite =  $13.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.0066 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +4 dB/oct  
80 - 200 Hz @  $0.041 \text{ g}^2/\text{Hz}$   
200 - 300 Hz @ -10 dB/oct  
300 - 1500 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0061 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0049 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 600 Hz @  $0.0098 \text{ g}^2/\text{Hz}$   
600 - 1000 Hz @ +3 dB/oct  
1000 - 1500 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0092 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

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**2-2-3-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 2-3 ET LH<sub>2</sub> Cylinder, Forward Section (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z Axis ±90°). (General Specifications)

Same as Subzone 2-3-1-A below.

Subzone 2-3-1-A Input to components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
Weight of Component < 15 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
20 - 120 Hz @ +9 dB/oct  
120 - 160 Hz @ 1.3 g<sup>2</sup>/Hz  
160 - 280 Hz @ -6 dB/oct  
280 - 900 Hz @ 0.43 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.09 g<sup>2</sup>/Hz

Composite = 25.2 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
20 - 90 Hz @ +9 dB/oct  
90 - 220 Hz @ 0.025 g<sup>2</sup>/Hz  
220 - 270 Hz @ +9 dB/oct  
270 - 1000 Hz @ 0.045 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.023 g<sup>2</sup>/Hz

Composite = 8.4 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
20 - 75 Hz @ +6 dB/oct  
75 - 170 Hz @ 0.56 g<sup>2</sup>/Hz  
170 - 240 Hz @ +6 dB/oct  
240 - 900 Hz @ 1.13 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.51 g<sup>2</sup>/Hz

Composite = 41.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 440 Hz @ 0.048 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.061 g<sup>2</sup>/Hz

Composite = 12.6 g<sub>rms</sub>

2-3-1-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +9 dB/oct  
120 - 160 Hz @  $5.0 \text{ g}^2/\text{Hz}$   
160 - 280 Hz @ -6 dB/oct  
280 - 900 Hz @  $1.7 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.36 \text{ g}^2/\text{Hz}$

Composite =  $50.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0013 \text{ g}^2/\text{Hz}$   
20 - 90 Hz @ +9 dB/oct  
90 - 220 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
220 - 270 Hz @ +9 dB/oct  
270 - 1000 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.09 \text{ g}^2/\text{Hz}$

Composite =  $16.7 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-1-B Input to Components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and NOT within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
Weight of Component ≥ 15 but < 45 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
20 - 96 Hz @ +9 dB/oct  
96 - 160 Hz @ 0.63 g<sup>2</sup>/Hz  
160 - 280 Hz @ -6 dB/oct  
280 - 900 Hz @ 0.22 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 18.2 z<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
20 - 72 Hz @ +9 dB/oct  
72 - 220 Hz @ 0.013 g<sup>2</sup>/Hz  
220 - 270 Hz @ +9 dB/oct  
270 - 1000 Hz @ 0.023 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 5.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
20 - 52 Hz @ +6 dB/oct  
52 - 120 Hz @ 0.28 g<sup>2</sup>/Hz  
120 - 170 Hz @ +6 dB/oct  
170 - 900 Hz @ 0.56 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.26 g<sup>2</sup>/Hz

Composite = 29.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
20 - 80 Hz @ +9 dB/oct  
80 - 440 Hz @ 0.024 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 8.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
20 - 96 Hz @ +9 dB/oct  
96 - 160 Hz @ 2.5 g<sup>2</sup>/Hz  
160 - 280 Hz @ -6 dB/oct  
280 - 900 Hz @ 0.86 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.18 g<sup>2</sup>/Hz

Composite = 36.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
20 - 72 Hz @ +9 dB/oct  
72 - 220 Hz @ 0.05 g<sup>2</sup>/Hz  
220 - 270 Hz @ +9 dB/oct  
270 - 1000 Hz @ 0.09 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 11.8 g<sub>rms</sub>

**2-3-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 2-3-1-C Input to Components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component ≥ 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
 20 - 75 Hz @ +9 dB/oct  
 75 - 160 Hz @ 0.3 g<sup>2</sup>/Hz  
 160 - 280 Hz @ -6 dB/oct  
 280 - 900 Hz @ 0.1 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.021 g<sup>2</sup>/Hz

Composite = 12.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 220 Hz @ 0.011 g<sup>2</sup>/Hz  
 220 - 270 Hz @ +9 dB/oct  
 270 - 1000 Hz @ 0.0063  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0058 g<sup>2</sup>/Hz

Composite = 4.2 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 37 Hz @ +6 dB/oct  
 37 - 85 Hz @ 0.14 g<sup>2</sup>/Hz  
 85 - 120 Hz @ +6 dB/oct  
 120 - 900 Hz @ 0.28 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite = 20.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
 20 - 63 Hz @ +9 dB/oct  
 63 - 440 Hz @ 0.012 g<sup>2</sup>/Hz  
 440 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.030 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 6.4 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 75 Hz @ +9 dB/oct  
 75 - 160 Hz @ 1.2 g<sup>2</sup>/Hz  
 160 - 280 Hz @ -6 dB/oct  
 280 - 900 Hz @ 0.4 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.082 g<sup>2</sup>/Hz

Composite = 25.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 220 Hz @ 0.025 g<sup>2</sup>/Hz  
 220 - 270 Hz @ +9 dB/oct  
 270 - 1000 Hz @ 0.045 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.023 g<sup>2</sup>/Hz

Composite = 8.4 g<sub>rms</sub>

**2-3-1-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-3-1-AP Input to Components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 15 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +9 dB/oct  
 150 - 250 Hz @ 2.5 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.75 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.16 g<sup>2</sup>/Hz

Composite = 35.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
 20 - 90 Hz @ +9 dB/oct  
 90 - 140 Hz @ 0.025 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 10.8 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 75 Hz @ +6 dB/oct  
 75 - 170 Hz @ 0.56 g<sup>2</sup>/Hz  
 170 - 240 Hz @ +6 dB/oct  
 240 - 900 Hz @ 1.13 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.51 g<sup>2</sup>/Hz

Composite = 41.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +9 dB/oct  
 100 - 440 Hz @ 0.348 g<sup>2</sup>/Hz  
 440 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.061 g<sup>2</sup>/Hz

Composite = 12.6 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +9 dB/oct  
 150 - 250 Hz @ 10.0 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 3.0 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.62 g<sup>2</sup>/Hz

Composite = 71.2 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 90 Hz @ +9 dB/oct  
 90 - 140 Hz @ 0.1 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.3 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 21.6 g<sub>rms</sub>

**2-3-1-AP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

**2 - 5 Hz @ 0.6 G's peak\***

**5 - 40 Hz @ 0.6 G's peak**

**Lateral Axes**

**2 - 5 Hz @ 0.8 G's peak\***

**5 - 40 Hz @ 0.8 G's peak**

**5. Shock Test Criteria (2 shocks/axis)**

**See Table I**

**\* Design Criteria Only**

Subzone 2-3-1-BP Input to Components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and within ± 10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation.  
 Weight of Component ≥ 15 lb. but < 45 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +9 dB/oct  
 120 - 250 Hz @ 1.3 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.38 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 25.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
 20 - 72 Hz @ +9 dB/oct  
 72 - 140 Hz @ 0.013 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.038 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 7.7 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 52 Hz @ +6 dB/oct  
 52 - 120 Hz @ 0.28 g<sup>2</sup>/Hz  
 120 - 170 Hz @ +6 dB/oct  
 170 - 900 Hz @ 0.56 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.26 g<sup>2</sup>/Hz

Composite = 29.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
 20 - 80 Hz @ +9 dB/oct  
 80 - 440 Hz @ 0.024 g<sup>2</sup>/Hz  
 440 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 8.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +9 dB/oct  
 120 - 250 Hz @ 5.0 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 1.5 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.30 g<sup>2</sup>/Hz

Composite = 51.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 72 Hz @ +9 dB/oct  
 72 - 140 Hz @ 0.05 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 15.3 g<sub>rms</sub>

**2-3-1-BP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-3-1-CP Input to Components mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank, Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component ≥ 45 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
 20 - 96 Hz @ +9 dB/oct  
 96 - 250 Hz @ 0.63 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.19 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 18.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 140 Hz @ 0.0063 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.019 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0095 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 37 Hz @ +6 dB/oct  
 37 - 85 Hz @ 0.14 g<sup>2</sup>/Hz  
 85 - 120 Hz @ +6 dB/oct  
 120 - 900 Hz @ 0.28 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite = 20.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
 20 - 63 Hz @ +9 dB/oct  
 63 - 440 Hz @ 0.012 g<sup>2</sup>/Hz  
 440 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.030 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 6.4 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 96 Hz @ +9 dB/oct  
 96 - 250 Hz @ 2.5 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.75 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 37.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 56 Hz @ +9 dB/oct  
 56 - 140 Hz @ 0.025 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 10.8 g<sub>rms</sub>

**2-3-1-CP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 2-3-1-DP Input to Components Mounted on Baffles and Stiffened Skin on the LH<sub>2</sub> Tank Forward Section (X<sub>T</sub> 1624 to X<sub>T</sub> 1123), Inboard Half (+Z ±90°) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component 100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0063 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +9 dB/oct  
 76 - 250 Hz @ 0.31 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.095 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 13.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00033 g<sup>2</sup>/Hz  
 20 - 45 Hz @ +9 dB/oct  
 45 - 140 Hz @ 0.0033 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.0095 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0048 g<sup>2</sup>/Hz

Composite = 3.8 g<sub>rms</sub>

2. Lift-off Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 26 Hz @ +6 dB/oct  
 26 - 85 Hz @ 0.07 g<sup>2</sup>/Hz  
 85 - 120 Hz @ +6 dB/oct  
 120 - 900 Hz @ 0.14 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.065 g<sup>2</sup>/Hz

Composite = 14.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00039 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +9 dB/oct  
 50 - 440 Hz @ 0.006 g<sup>2</sup>/Hz  
 440 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.015 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.0075 g<sup>2</sup>/Hz

Composite = 4.5 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +9 dB/oct  
 76 - 250 Hz @ 1.25 g<sup>2</sup>/Hz  
 250 - 360 Hz @ -10 dB/oct  
 360 - 900 Hz @ 0.38 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 26.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 45 Hz @ +9 dB/oct  
 45 - 140 Hz @ 0.013 g<sup>2</sup>/Hz  
 140 - 210 Hz @ +9 dB/oct  
 210 - 1000 Hz @ 0.038 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 7.6 g<sub>rms</sub>

2-3-1-DP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-2      Structural Rings at Stations  $X_T$  1624 and  $X_T$  1377 in the ET LH<sub>2</sub> Cylinder, Inboard Half (+Z Axis  $\pm 90^\circ$ ).  
(General Specifications)

Same as Subzone 2-3-2-A below.

Subzone 2-3-2-A      Input to Components mounted on Structural Ring at  $X_T$  1624 and  $X_T$  1377 in the LH<sub>2</sub> Tank, Inboard Half (+Z  $\pm 90^\circ$ ), and not within  $\pm 10^\circ$  of the GO<sub>2</sub> Press.  
Line/Cable Tray Installation. Weight of Component < 30 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.02 g<sup>2</sup>/Hz  
20 - 60 Hz @ +6 dB/oct  
60 - 350 Hz @ 0.18 g<sup>2</sup>/Hz  
350 - 500 Hz @ +10 dB/oct  
500 - 1000 Hz @ 0.63 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.063 g<sup>2</sup>/Hz

Composite = 25.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.013 g<sup>2</sup>/Hz  
20 - 50 Hz @ +3 dB/oct  
50 - 190 Hz @ 0.033 g<sup>2</sup>/Hz  
190 - 400 Hz @ +10 dB/oct  
400 - 900 Hz @ 0.38 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.028 g<sup>2</sup>/Hz

Composite = 18.7 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0061 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 290 Hz @ 0.15 g<sup>2</sup>/Hz  
290 - 500 Hz @ +9 dB/oct  
500 - 850 Hz @ 0.80 g<sup>2</sup>/Hz  
850 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.15 g<sup>2</sup>/Hz

Composite = 28.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0065 g<sup>2</sup>/Hz  
20 - 60 Hz @ +6 dB/oct  
60 - 190 Hz @ 0.060 g<sup>2</sup>/Hz  
190 - 340 Hz @ +9 dB/oct  
340 - 2000 Hz @ 0.34 g<sup>2</sup>/Hz

Composite = 24.2 g<sub>rms</sub>

2-3-2-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 350 Hz @  $0.7 \text{ g}^2/\text{Hz}$   
350 - 500 Hz @ +10 dB/oct  
500 - 1000 Hz @  $2.5 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.25 \text{ g}^2/\text{Hz}$

Composite =  $50.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.053 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 190 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
190 - 400 Hz @ +10 dB/oct  
400 - 900 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $37.3 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-2-B Input to Components mounted on Structural Ring at  
 $X_T$  1624 and  $X_T$  1377 in the  $LH_2$  Tank, Inboard Half  
 (+Z  $\pm 90^\circ$ ), and not within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/C ble Tray Installation. Weight of Component  
 $\geq 30$  but  $< 90$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 20 - 43 Hz @ +6 dB/oct  
 43 - 340 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 1000 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.03 \text{ g}^2/\text{Hz}$

Composite =  $17.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0093 \text{ g}^2/\text{Hz}$   
 20 - 35 Hz @ +3 dB/oct  
 35 - 190 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 190 - 400 Hz @ +10 dB/oct  
 400 - 900 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $13.2 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0061 \text{ g}^2/\text{Hz}$   
 20 - 72 Hz @ +6 dB/oct  
 72 - 290 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 290 - 500 Hz @ +9 dB/oct  
 500 - 850 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 850 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.072 \text{ g}^2/\text{Hz}$

Composite =  $19.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 190 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @  $0.17 \text{ g}^2/\text{Hz}$

Composite =  $17.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
 20 - 43 Hz @ +6 dB/oct  
 43 - 340 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 1000 Hz @  $1.2 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.12 \text{ g}^2/\text{Hz}$

Composite =  $35.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
 20 - 35 Hz @ +3 dB/oct  
 35 - 190 Hz @  $0.065 \text{ g}^2/\text{Hz}$   
 190 - 400 Hz @ +10 dB/oct  
 400 - 900 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.054 \text{ g}^2/\text{Hz}$

Composite =  $26.4 \text{ g}_{\text{rms}}$

**2-3-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-3-2-C Input to Components mounted on Structural Ring at  
 $X_T$  1624 and  $X_T$  1377 in the  $LH_2$  Tank, Inboard Half  
 (+Z  $\pm 90^\circ$ ), and not within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/Cable Tray Installation. Weight of Component  
 $\geq 90$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 340 Hz @  $0.043 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 1000 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $12.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 25 Hz @ +3 dB/oct  
 25 - 190 Hz @  $0.008 \text{ g}^2/\text{Hz}$   
 190 - 400 Hz @ +10 dB/oct  
 400 - 900 Hz @  $0.093 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.0068 \text{ g}^2/\text{Hz}$

Composite =  $9.3 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0061 \text{ g}^2/\text{Hz}$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 290 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 290 - 500 Hz @ +9 dB/oct  
 500 - 850 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 850 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.036 \text{ g}^2/\text{Hz}$

Composite =  $14.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 190 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 340 Hz @  $0.17 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 1000 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.06 \text{ g}^2/\text{Hz}$

Composite =  $24.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 25 Hz @ +3 dB/oct  
 25 - 190 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
 190 - 400 Hz @ +10 dB/oct  
 400 - 900 Hz @  $0.37 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.027 \text{ g}^2/\text{Hz}$

Composite =  $18.5 \text{ g}_{\text{rms}}$

**2-3-2-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 2-3-2-AP Input to Components mounted on Structural Ring at  
 $X_T$  1624 and  $X_T$  1377 in the  $LH_2$  Tank, Inboard Half  
 (+Z  $\pm 90^\circ$ ) and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
 Cable Tray Installation. Weight of Component < 30  
 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 64 - 64 Hz @ +6 dB/oct  
 120 - 120 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
 200 - 200 Hz @ +6 dB/oct  
 340 - 340 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 500 - 500 Hz @ +10 dB/oct  
 800 - 800 Hz @  $1.8 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.088 \text{ g}^2/\text{Hz}$

Composite =  $36.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 50 - 50 Hz @ +3 dB/oct  
 130 - 130 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 400 - 400 Hz @ +9 dB/oct  
 800 - 800 Hz @  $0.95 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.045 \text{ g}^2/\text{Hz}$

Composite =  $27.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.0061 \text{ g}^2/\text{Hz}$   
 100 - 100 Hz @ +6 dB/oct  
 290 - 290 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 500 - 500 Hz @ +9 dB/oct  
 850 - 850 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $28.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 60 - 60 Hz @ +6 dB/oct  
 190 - 190 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 340 - 340 Hz @ +9 dB/oct  
 2000 - 2000 Hz @  $0.34 \text{ g}^2/\text{Hz}$

Composite =  $24.2 \text{ g}_{\text{rms}}$

2-3-2-AP (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
64 - 64 Hz @ +6 dB/oct  
64 - 120 Hz @  $0.8 \text{ g}^2/\text{Hz}$   
120 - 200 Hz @ +6 dB/oct  
200 - 340 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
340 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $7.0 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.35 \text{ g}^2/\text{Hz}$

Composite =  $72.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.053 \text{ g}^2/\text{Hz}$   
50 - 50 Hz @ +3 dB/oct  
50 - 130 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
130 - 400 Hz @ +9 dB/oct  
400 - 800 Hz @  $3.8 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.18 \text{ g}^2/\text{Hz}$

Composite =  $55.3 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-2-BP Input to Components mounted on Structural Ring at  
 $X_T$  1624 and  $X_T$  1377 in the  $LH_2$  Tank, Inboard Half  
 (+Z  $\pm 90^\circ$ ) and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
 Cable Tray Installation. Weight of Component  $\geq 30$   
 but  $< 90$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 20 - 46 Hz @ +6 dB/oct  
 46 - 120 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 120 - 200 Hz @ +6 dB/oct  
 200 - 340 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.8 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.043 \text{ g}^2/\text{Hz}$

Composite =  $25.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0093 \text{ g}^2/\text{Hz}$   
 20 - 35 Hz @ +3 dB/oct  
 35 - 130 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
 130 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $0.48 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $19.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0061 \text{ g}^2/\text{Hz}$   
 20 - 72 Hz @ +6 dB/oct  
 72 - 290 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 290 - 500 Hz @ +9 dB/oct  
 500 - 850 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 850 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.072 \text{ g}^2/\text{Hz}$

Composite =  $19.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 190 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @  $0.17 \text{ g}^2/\text{Hz}$

Composite =  $17.4 \text{ g}_{\text{rms}}$

2-3-2-BP (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
46 - 46 Hz @ +6 dB/oct  
120 - 120 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
200 - 200 Hz @ +6 dB/oct  
340 - 340 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
500 - 500 Hz @ +10 dB/oct  
800 - 800 Hz @  $3.5 \text{ g}^2/\text{Hz}$   
2000 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.17 \text{ g}^2/\text{Hz}$

Composite =  $51.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.037 \text{ g}^2/\text{Hz}$   
35 - 35 Hz @ +3 dB/oct  
130 - 130 Hz @  $0.065 \text{ g}^2/\text{Hz}$   
400 - 400 Hz @ +9 dB/oct  
800 - 800 Hz @  $1.9 \text{ g}^2/\text{Hz}$   
2000 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.094 \text{ g}^2/\text{Hz}$

Composite =  $39.1 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-2-CP Input to Components mounted on Structural Ring At  
 $X_T$  1624 and  $X_T$  1377 in the  $LH_2$  Tank, Inboard Half  
 (+Z  $\pm 90^\circ$ ), and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
 Cable Tray Installation. Weight of Component  $\geq 90$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 20 - 32 Hz @ +6 dB/oct  
 32 - 120 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 120 - 200 Hz @ +6 dB/oct  
 200 - 340 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.43 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.021 \text{ g}^2/\text{Hz}$

Composite =  $18.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 25 Hz @ +3 dB/oct  
 25 - 130 Hz @  $0.008 \text{ g}^2/\text{Hz}$   
 130 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.01 \text{ g}^2/\text{Hz}$

Composite =  $13.1 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0061 \text{ g}^2/\text{Hz}$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 290 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 290 - 500 Hz @ +9 dB/oct  
 500 - 850 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 850 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.036 \text{ g}^2/\text{Hz}$

Composite =  $14.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 190 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

2-3-2-CP (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.078 \text{ g}^2/\text{Hz}$   
32 - 32 Hz @ +6 dB/oct  
32 - 120 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
120 - 200 Hz @ +6 dB/oct  
200 - 340 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
340 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $1.7 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.082 \text{ g}^2/\text{Hz}$

Composite =  $36.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
25 - 25 Hz @ +3 dB/oct  
25 - 130 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
130 - 400 Hz @ +9 dB/oct  
400 - 800 Hz @  $0.85 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.04 \text{ g}^2/\text{Hz}$

Composite =  $26.2 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-3      Structural Ring at Station  $X_T$  1130 in the ET  $LH_2$  Cylinder, Inboard Half (+Z Axis  $\pm 90^\circ$ ). (General Specifications)

Same as Subzone 2-3-3-A below.

Subzone 2-3-3-A    Input to Components mounted on the Structural Ring  $X_T$  1130 in the  $LH_2$  Tank, Inboard Half (+Z  $\pm 90^\circ$ ), and not within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component < 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
20 - 80 Hz @ +3 dB/oct  
80 - 130 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
130 - 260 Hz @ -3 dB/oct  
260 - 1500 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $8.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +3 dB/oct  
50 - 300 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
300 - 700 Hz @ +3 dB/oct  
700 - 1500 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $11.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 200 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
200 - 250 Hz @ -9 dB/oct  
250 - 1400 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.031 \text{ g}^2/\text{Hz}$

Composite =  $12.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 50 Hz @  $0.032 \text{ g}^2/\text{Hz}$   
50 - 1000 Hz @ +2 dB/oct  
1000 - 1400 Hz @  $0.26 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.13 \text{ g}^2/\text{Hz}$

Composite =  $19.1 \text{ g}_{\text{rms}}$

2-3-3-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.076 \text{ g}^2/\text{Hz}$   
80 - 80 Hz @ +3 dB/oct  
80 - 130 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
130 - 260 Hz @ -3 dB/oct  
260 - 1500 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.09 \text{ g}^2/\text{Hz}$

Composite =  $17.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.06 \text{ g}^2/\text{Hz}$   
50 - 50 Hz @ +3 dB/oct  
50 - 300 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
300 - 700 Hz @ +3 dB/oct  
700 - 1500 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.2 \text{ g}^2/\text{Hz}$

Composite =  $23.4 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-3-3-B Input to Components mounted on the Structural Ring at X<sub>T</sub> 1130 in the LH<sub>2</sub> Tank, Inboard Half (+Z ±90°), and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component ≥ 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013 g<sup>2</sup>/Hz  
 20 - 58 Hz @ +3 dB/oct  
 58 - 130 Hz @ 0.038 g<sup>2</sup>/Hz  
 130 - 260 Hz @ -3 dB/oct  
 260 - 1500 Hz @ 0.02 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 6.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.011 g<sup>2</sup>/Hz  
 20 - 35 Hz @ +3 dB/oct  
 35 - 300 Hz @ 0.019 g<sup>2</sup>/Hz  
 300 - 700 Hz @ +3 dB/oct  
 700 - 1500 Hz @ 0.043 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 8.1 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.11 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +4 dB/oct  
 100 - 200 Hz @ 0.090 g<sup>2</sup>/Hz  
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @ 0.045 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 9.1 g<sub>rms</sub>

Long. and Tang. Axes

20 - 50 Hz @ 0.016 g<sup>2</sup>/Hz  
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @ 0.13 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.065 g<sup>2</sup>/Hz

Composite = 13.5 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.051 g<sup>2</sup>/Hz  
 20 - 58 Hz @ +3 dB/oct  
 58 - 130 Hz @ 0.15 g<sup>2</sup>/Hz  
 130 - 260 Hz @ -3 dB/oct  
 260 - 1500 Hz @ 0.08 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 12.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.042 g<sup>2</sup>/Hz  
 20 - 35 Hz @ +3 dB/oct  
 35 - 300 Hz @ 0.074 g<sup>2</sup>/Hz  
 300 - 700 Hz @ +3 dB/oct  
 700 - 1500 Hz @ 0.17 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.098 g<sup>2</sup>/Hz

Composite = 16.2 g<sub>rms</sub>

2-3-3-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-3-AP Input to Components mounted on the Structural Ring at X<sub>T</sub> 1130 in the LH<sub>2</sub> Tank, Inboard Half (+Z ±90°), and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.019 g<sup>2</sup>/Hz  
 20 - 150 Hz @ -3 dB/oct  
 150 - 250 Hz @ 0.14 g<sup>2</sup>/Hz  
 250 - 290 Hz @ -10 dB/oct  
 290 - 1000 Hz @ 0.088 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 12.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.015 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +3 dB/oct  
 50 - 115 Hz @ 0.038 g<sup>2</sup>/Hz  
 115 - 200 Hz @ +6 dB/oct  
 200 - 400 Hz @ 0.11 g<sup>2</sup>/Hz  
 400 - 600 Hz @ +3 dB/oct  
 600 - 1500 Hz @ 0.17 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.093 g<sup>2</sup>/Hz

Composite = 16.5 g<sub>rms</sub>

2 Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +4 dB/oct  
 120 - 200 Hz @ 0.18 g<sup>2</sup>/Hz  
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @ 0.090 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.031 g<sup>2</sup>/Hz

Composite = 12.8 g<sub>rms</sub>

Long. and Tang. Axes

20 - 50 Hz @ 0.032 g<sup>2</sup>/Hz  
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @ 0.26 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.13 g<sup>2</sup>/Hz

Composite = 19.1 g<sub>rms</sub>

### 2-3-3-AP (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 Hz @ 0.076  $g^2/Hz$   
20 - 150 Hz @ +3 dB/oct  
150 - 250 Hz @ 0.56  $g^2/Hz$   
250 - 290 Hz @ -10 dB/oct  
290 - 1000 Hz @ 0.35  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.18  $g^2/Hz$

Composite = 24.6  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.06  $g^2/Hz$   
20 - 50 Hz @ +3 dB/oct  
50 - 115 Hz @ 0.15  $g^2/Hz$   
115 - 200 Hz @ +6 dB/oct  
200 - 400 Hz @ 0.45  $g^2/Hz$   
400 - 600 Hz @ +3 dB/oct  
600 - 1500 Hz @ 0.66  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.37  $g^2/Hz$

Composite = 32.9  $g_{rms}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-3-3-BP Input to Components mounted on the Structural Ring at X<sub>T</sub> 1130 in the LH<sub>2</sub> Tank, Inboard Half (+Z ±90°), and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component ≥ 100 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013 g<sup>2</sup>/Hz  
 20 - 110 Hz @ +3 dB/oct  
 110 - 250 Hz @ 0.07 g<sup>2</sup>/Hz  
 250 - 290 Hz @ -10 dB/oct  
 290 - 1000 Hz @ 0.043 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.023 g<sup>2</sup>/Hz

Composite = 8.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.01 g<sup>2</sup>/Hz  
 20 - 36 Hz @ +3 dB/oct  
 36 - 115 Hz @ 0.019 g<sup>2</sup>/Hz  
 115 - 200 Hz @ +6 dB/oct  
 200 - 400 Hz @ 0.055 g<sup>2</sup>/Hz  
 400 - 600 Hz @ +3 dB/oct  
 600 - 1500 Hz @ 0.083 g<sup>2</sup>/Hz  
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.048 g<sup>2</sup>/Hz

Composite = 11.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.11 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +4 dB/oct  
 100 - 200 Hz @ 0.090 g<sup>2</sup>/Hz  
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @ 0.045 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 9.1 g<sub>rms</sub>

Long. and Tang. Axes

20 - 50 Hz @ 0.016 g<sup>2</sup>/Hz  
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @ 0.13 g<sup>2</sup>/Hz  
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.065 g<sup>2</sup>/Hz

Composite = 13.5 g<sub>rms</sub>

## 2-3-3-BF (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 Hz @ 0.05  $g^2/Hz$   
20 - 110 Hz @ +3 dB/oct  
110 - 250 Hz @ 0.28  $g^2/Hz$   
250 - 290 Hz @ -10 dB/oct  
290 - 1000 Hz @ 0.17  $g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.09  $g^2/Hz$

Composite = 17.4  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.041  $g^2/Hz$   
20 - 36 Hz @ +3 dB/oct  
36 - 115 Hz @ 0.075  $g^2/Hz$   
115 - 200 Hz @ +6 dB/oct  
200 - 400 Hz @ 0.22  $g^2/Hz$   
400 - 600 Hz @ +3 dB/oct  
600 - 1500 Hz @ 0.33  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.19  $g^2/Hz$

Composite = 23.0  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-4 ET LH<sub>2</sub> Cylinder, Forward Section (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1130 ), Outboard Half (-Z Axis ±90°). (General Specifications)

Same as Subzone 2-4-1-A below.

Subzone 2-4-1 Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1130), Outboard Half (-Z Axis ±90°). (General Specifications)

Same as Subzone 2-4-1-A below.

Subzone 2-4-1-A Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Sections (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1130), Outboard Half (-Z Axis ±90°).  
Weight of Component < 15 lb.

# 1. Acceptance Test Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.013 g<sup>2</sup>/Hz  
20 - 75 Hz @ +6 dB/oct  
75 - 170 Hz @ 0.18 g<sup>2</sup>/Hz  
170 - 240 Hz @ +6 dB/oct  
240 - 900 Hz @ 0.35 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.16 g<sup>2</sup>/Hz

Composite = 22.8 g<sub>rms</sub>

## Long. and Tang. Axes

20 Hz @ 0.00012 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 440 Hz @ 0.015 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.038 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 7.0 g<sub>rms</sub>

# 2. Lift-off Random Vibration Criteria (1 min/axis)

## Radial Axis

20 Hz @ 0.052 g<sup>2</sup>/Hz  
20 - 75 Hz @ +6 dB/oct  
75 - 170 Hz @ 0.70 g<sup>2</sup>/Hz  
170 - 240 Hz @ +6 dB/oct  
240 - 900 Hz @ 1.40 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.63 g<sup>2</sup>/Hz

Composite = 45.6 g<sub>rms</sub>

## Long. and Tang. Axes

20 Hz @ 0.00048 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 440 Hz @ 0.060 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.15 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.075 g<sup>2</sup>/Hz

Composite = 14.0 g<sub>rms</sub>

2-4-1-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.052 \text{ g}^2/\text{Hz}$   
20 - 125 Hz @ +6 dB/oct  
125 - 200 Hz @  $2.00 \text{ g}^2/\text{Hz}$   
200 - 340 Hz @ -9 dB/oct  
340 - 1000 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $28.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0014 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 1000 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.018 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 2-4-1-B Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1130), Outboard Half (-Z Axis ±90°).  
Weight of Component ≥ 15 but < 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013 g<sup>2</sup>/Hz  
20 - 52 Hz @ +6 dB/oct  
52 - 120 Hz @ 0.088 g<sup>2</sup>/Hz  
120 - 170 Hz @ +6 dB/oct  
170 - 900 Hz @ 0.18 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.080 g<sup>2</sup>/Hz

Composite = 16.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00012 g<sup>2</sup>/Hz  
20 - 80 Hz @ +9 dB/oct  
80 - 440 Hz @ 0.0075 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.019 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0095 g<sup>2</sup>/Hz

Composite = 4.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.052 g<sup>2</sup>/Hz  
20 - 52 Hz @ +6 dB/oct  
52 - 120 Hz @ 0.35 g<sup>2</sup>/Hz  
120 - 170 Hz @ +6 dB/oct  
170 - 900 Hz @ 0.70 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.32 g<sup>2</sup>/Hz

Composite = 32.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00048 g<sup>2</sup>/Hz  
20 - 80 Hz @ +9 dB/oct  
80 - 440 Hz @ 0.030 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.075 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 9.9 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.052 g<sup>2</sup>/Hz  
20 - 87 Hz @ +6 dB/oct  
87 - 200 Hz @ 1.00 g<sup>2</sup>/Hz  
200 - 340 Hz @ -9 dB/oct  
340 - 1000 Hz @ 0.20 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.050 g<sup>2</sup>/Hz

Composite = 20.9 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0014 g<sup>2</sup>/Hz  
20 - 72 Hz @ +6 dB/oct  
72 - 1000 Hz @ 0.018 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0090 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

2-4-1-R (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-4-1-C Input to Components Mounted on Baffles and Stiffened Skin on the ET LH<sub>2</sub> Cylinder, Aft Section (Stations X<sub>T</sub> 1624 to X<sub>T</sub> 1130), Outboard Half (-Z Axis  $\pm 90^\circ$ ).  
Weight of Component  $\geq 45$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013 g<sup>2</sup>/Hz  
20 - 37 Hz @ +6 dB/oct  
37 - 85 Hz @ 0.045 g<sup>2</sup>/Hz  
85 - 120 Hz @ +6 dB/oct  
120 - 900 Hz @ 0.088 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.040 g<sup>2</sup>/Hz

Composite = 11.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00012 g<sup>2</sup>/Hz  
20 - 63 Hz @ +9 dB/oct  
63 - 440 Hz @ 0.0038 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.0095 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0048 g<sup>2</sup>/Hz

Composite = 3.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.052 g<sup>2</sup>/Hz  
20 - 37 Hz @ +6 dB/oct  
37 - 85 Hz @ 0.18 g<sup>2</sup>/Hz  
85 - 120 Hz @ +6 dB/oct  
120 - 900 Hz @ 0.35 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.16 g<sup>2</sup>/Hz

Composite = 23.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00048 g<sup>2</sup>/Hz  
20 - 63 Hz @ +9 dB/oct  
63 - 440 Hz @ 0.015 g<sup>2</sup>/Hz  
440 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @ 0.008 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 7.1 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.052 g<sup>2</sup>/Hz  
20 - 62 Hz @ +6 dB/oct  
62 - 200 Hz @ 0.50 g<sup>2</sup>/Hz  
200 - 340 Hz @ -9 dB/oct  
340 - 1000 Hz @ 0.10 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 15.1 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0014 g<sup>2</sup>/Hz  
20 - 67 Hz @ +6 dB/oct  
67 - 1000 Hz @ 0.015 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.0073 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

**2-4-1-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 2-4-2      Structural Rings at Stations  $X_T$  1624 and  $X_T$  1377 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ).  
(General Specifications)

Same as Subzone 2-4-2-A below.

Subzone 2-4-2-A      Input to Components Mounted on the Structural Rings at Stations  $X_T$  1624 and  $X_T$  1377 in the ET  $LH_2$  Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component < 30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0021 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 280 Hz @  $0.052 \text{ g}^2/\text{Hz}$   
280 - 490 Hz @ +9 dB/oct  
490 - 800 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.045 \text{ g}^2/\text{Hz}$

Composite =  $16.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0024 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 190 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
190 - 340 Hz @ +9 dB/oct  
340 - 2000 Hz @  $0.12 \text{ g}^2/\text{Hz}$

Composite =  $14.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0085 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 280 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
280 - 490 Hz @ +9 dB/oct  
490 - 800 Hz @  $1.10 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.18 \text{ g}^2/\text{Hz}$

Composite =  $32.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0096 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 190 Hz @  $0.088 \text{ g}^2/\text{Hz}$   
190 - 340 Hz @ +9 dB/oct  
340 - 2000 Hz @  $0.50 \text{ g}^2/\text{Hz}$

Composite =  $29.3 \text{ g}_{\text{rms}}$

2-4-2-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.034 \text{ g}^2/\text{Hz}$   
60 Hz @ +6 dB/oct  
60 - 280 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
280 - 500 Hz @ +6 dB/oct  
500 - 700 Hz @  $1.00 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.031 \text{ g}^2/\text{Hz}$

Composite =  $26.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0067 \text{ g}^2/\text{Hz}$   
60 Hz @ +6 dB/oct  
60 - 270 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
270 - 460 Hz @ +10 dB/oct  
460 - 800 Hz @  $0.36 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.017 \text{ g}^2/\text{Hz}$

Composite =  $16.7 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-4-2-B Input to Components Mounted on the Structural Rings  
 at Stations  $X_T$  1624 and  $X_T$  1377 in the ET  $LH_2$   
 Cylinder, Outboard Half ( $-Z$  Axis  $\pm 90^\circ$ ). Weight of  
 Component  $\geq 30$  but  $< 90$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.0021 \text{ g}^2/\text{Hz}$   
 71 - 71 Hz @ +6 dB/oct  
 71 - 280 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 280 - 490 Hz @ +9 dB/oct  
 490 - 800 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.022 \text{ g}^2/\text{Hz}$

Composite =  $11.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0024 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 190 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +6 dB/oct  
 340 - 2000 Hz @  $0.062 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.0085 \text{ g}^2/\text{Hz}$   
 71 - 71 Hz @ +6 dB/oct  
 71 - 280 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 280 - 490 Hz @ +9 dB/oct  
 490 - 800 Hz @  $0.55 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.089 \text{ g}^2/\text{Hz}$

Composite =  $22.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0096 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 190 Hz @  $0.044 \text{ g}^2/\text{Hz}$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @  $0.25 \text{ g}^2/\text{Hz}$

Composite =  $21.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.024 \text{ g}^2/\text{Hz}$   
 50 - 50 Hz @ +6 dB/oct  
 50 - 280 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 280 - 500 Hz @ +6 dB/oct  
 500 - 700 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $18.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0048 \text{ g}^2/\text{Hz}$   
 50 - 50 Hz @ +6 dB/oct  
 50 - 270 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 270 - 460 Hz @ +10 dB/oct  
 460 - 800 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.0086 \text{ g}^2/\text{Hz}$

Composite =  $11.8 \text{ g}_{\text{rms}}$

**2-4-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 2-4-2-C Input to Components Mounted on the Structural Rings  
 at Stations  $X_T$  1624 and  $X_T$  1377 in the ET LH<sub>2</sub>  
 Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). Weight of  
 Component  $\geq 90$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0021  $g^2/Hz$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 280 Hz @ 0.014  $g^2/Hz$   
 280 - 490 Hz @ +9 dB/oct  
 490 - 800 Hz @ 0.070  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.011  $g^2/Hz$

Composite = 8.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0024  $g^2/Hz$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 190 Hz @ 0.0055  $g^2/Hz$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @ 0.030  $g^2/Hz$

Composite = 7.3  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0085  $g^2/Hz$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 280 Hz @ 0.055  $g^2/Hz$   
 280 - 490 Hz @ +9 dB/oct  
 490 - 800 Hz @ 0.28  $g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.045  $g^2/Hz$

Composite = 16.3  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0096  $g^2/Hz$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 190 Hz @ 0.022  $g^2/Hz$   
 190 - 340 Hz @ +9 dB/oct  
 340 - 2000 Hz @ 0.12  $g^2/Hz$

Composite = 14.7  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.015  $g^2/Hz$   
 20 - 45 Hz @ +6 dB/oct  
 45 - 280 Hz @ 0.075  $g^2/Hz$   
 280 - 500 Hz @ +6 dB/oct  
 500 - 700 Hz @ 0.25  $g^2/Hz$   
 700 - 2000 Hz @ -10 dB/oct  
 2000 Hz @ 0.0076  $g^2/Hz$

Composite = 13.1  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.0030  $g^2/Hz$   
 20 - 45 Hz @ +6 dB/oct  
 45 - 270 Hz @ 0.015  $g^2/Hz$   
 270 - 460 Hz @ +10 dB/oct  
 460 - 800 Hz @ 0.090  $g^2/Hz$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @ 0.004  $g^2/Hz$

Composite = 8.4  $g_{rms}$

2-4-2-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-4-3      Structural Ring at Station  $X_T$  1130 in the ET  $LH_2$   
Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). (General  
Specifications)

Same as Subzone 2-4-3-A below.

Subzone 2-4-3-A    Input to Components Mounted on the Structural Ring  
at Station  $X_T$  1130 in the ET  $LH_2$  Cylinder, Outboard  
Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component < 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0070 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 200 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
200 - 250 Hz @ -9 dB/oct  
250 - 1400 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.01 \text{ g}^2/\text{Hz}$

Composite =  $8.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 50 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
50 - 1000 Hz @ +2 dB/oct  
1000 - 1400 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.055 \text{ g}^2/\text{Hz}$

Composite =  $12.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 200 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
200 - 250 Hz @ -9 dB/oct  
250 - 1400 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.052 \text{ g}^2/\text{Hz}$

Composite =  $16.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 50 Hz @  $0.056 \text{ g}^2/\text{Hz}$   
50 - 1000 Hz @ +2 dB/oct  
1000 - 1400 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
1400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.22 \text{ g}^2/\text{Hz}$

Composite =  $25.2 \text{ g}_{\text{rms}}$

## 2-4-3-A (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 - 20 Hz @ 0.024  $g^2/Hz$   
80 - 80 Hz @ +4 dB/oct  
80 - 200 Hz @ 0.15  $g^2/Hz$   
200 - 300 Hz @ -10 dB/oct  
300 - 1500 Hz @ 0.040  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.023  $g^2/Hz$

Composite = 10.0  $g_{rms}$

#### Long. and Tang. Axes

20 - 20 Hz @ 0.030  $g^2/Hz$   
40 - 40 Hz @ +3 dB/oct  
40 - 600 Hz @ 0.060  $g^2/Hz$   
600 - 1000 Hz @ +3 dB/oct  
1000 - 1500 Hz @ 0.10  $g^2/Hz$   
1500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.056  $g^2/Hz$

Composite = 12.4  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 2-4-3-B Input to Components Mounted on the Structural Ring at Station X<sub>T</sub> 1130 in the ET LH<sub>2</sub> Cylinder, Outboard Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component  $\geq 45$  but  $< 135$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0045 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 200 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0062 \text{ g}^2/\text{Hz}$

Composite =  $5.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 50 Hz @  $0.0070 \text{ g}^2/\text{Hz}$   
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @  $0.058 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.028 \text{ g}^2/\text{Hz}$

Composite =  $9.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +4 dB/oct  
 100 - 200 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $11.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 50 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @  $0.23 \text{ g}^2/\text{Hz}$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $18.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +4 dB/oct  
 80 - 190 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 190 - 300 Hz @ -10 dB/oct  
 300 - 1500 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.011 \text{ g}^2/\text{Hz}$

Composite =  $7.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 600 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 600 - 1000 Hz @ +3 dB/oct  
 1000 - 1500 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.028 \text{ g}^2/\text{Hz}$

Composite =  $8.8 \text{ g}_{\text{rms}}$

**2-4-3-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

**Subzone 2-4-3-C** Input to Components Mounted on the Structural Ring  
at Station X<sub>T</sub> 1130 in the ET LH<sub>2</sub> Cylinder, Outboard  
Half (-Z Axis  $\pm 90^\circ$ ). Weight of Component  $\geq 135$  lb.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.0030  $g^2/Hz$   
 20 - 80 Hz @ +4 dB/oct  
 80 - 200 Hz @ 0.019  $g^2/Hz$   
 200 - 250 Hz @ +9 dB/oct  
 250 - 1400 Hz @ 0.095  $g^2/Hz$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0032  $g^2/Hz$

Composite = 4.2  $g_{rms}$

**Long. and Tang. Axes**

20 - 50 Hz @ 0.0035  $g^2/Hz$   
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @ 0.030  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.017  $g^2/Hz$

Composite = 6.5  $g_{rms}$

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.012  $g^2/Hz$   
 20 - 80 Hz @ +4 dB/oct  
 80 - 200 Hz @ 0.075  $g^2/Hz$   
 200 - 250 Hz @ -9 dB/oct  
 250 - 1400 Hz @ 0.038  $g^2/Hz$   
 1400 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.013  $g^2/Hz$

Composite = 8.5  $g_{rms}$

**Long. and Tang. Axes**

20 - 50 Hz @ 0.014  $g^2/Hz$   
 50 - 1000 Hz @ +2 dB/oct  
 1000 - 1400 Hz @ 0.12  $g^2/Hz$   
 1400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.059  $g^2/Hz$

Composite = 13.0  $g_{rms}$

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @ 0.011  $g^2/Hz$   
 20 - 70 Hz @ +4 dB/oct  
 70 - 175 Hz @ 0.060  $g^2/Hz$   
 175 - 300 Hz @ -10 dB/oct  
 300 - 1500 Hz @ 0.010  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0056  $g^2/Hz$

Composite = 5.1  $g_{rms}$

**Long. and Tang. Axes**

20 Hz @ 0.0075  $g^2/Hz$   
 20 - 40 Hz @ +3 dB/oct  
 40 - 600 Hz @ 0.015  $g^2/Hz$   
 600 - 1000 Hz @ +3 dB/oct  
 1000 - 1500 Hz @ 0.025  $g^2/Hz$   
 1500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.014  $g^2/Hz$

Composite = 6.2  $g_{rms}$

**2-4-3-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Zone 3 ET Intertank

Subzone 3-1 ET Intertank (Stations  $X_T$  1130 to  $X_T$  852), Panels 1, 2, and 3 (General Specifications).

Same as Subzone 3-1-1 below.

Subzone 3-1-1 Structural Rings at Stations  $X_T$  1082,  $X_T$  1034,  $X_T$  941, and  $X_T$  897 in Panels 1, 2, and 3 of the ET Intertank (General Specifications).

Same as Subzone 3-1-1-1A below.

Subzone 3-1-1-1-A Input to Components mounted on Structural Rings at  $X_T$  941 and  $X_T$  897 in Panels 1, 2, and 3 of the Intertank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component < 25 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +6 dB/oct  
60 - 310 Hz @  $0.23 \text{ g}^2/\text{Hz}$   
310 - 400 Hz @ +9 dB/oct  
400 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $20.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0058 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +6 dB/oct  
60 - 270 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
270 - 450 Hz @ +12 dB/oct  
450 - 700 Hz @  $0.38 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$

Composite =  $14.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +9 dB/oct  
60 - 350 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
350 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.16 \text{ g}^2/\text{Hz}$

Composite =  $31.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +10 dB/oct  
60 - 200 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
200 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.080 \text{ g}^2/\text{Hz}$

Composite =  $22.9 \text{ g}_{\text{rms}}$

### 3-1-1-1A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 - 20 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +6 dB/oct  
60 - 310 Hz @  $0.9 \text{ g}^2/\text{Hz}$   
310 - 400 Hz @ +9 dB/oct  
400 - 800 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.058 \text{ g}^2/\text{Hz}$

Composite =  $40.9 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 - 20 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +6 dB/oct  
60 - 270 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
270 - 450 Hz @ +12 dB/oct  
450 - 700 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.026 \text{ g}^2/\text{Hz}$

Composite =  $29.7 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-1-B Input to Components mounted on Structural Rings at  
 $X_T$  941 and  $X_T$  897 in Panels 1, 2, and 3 of the Inter-  
 tank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
 Cable Tray Installation. Weight of Component  $\geq 25$   
 but  $< 75$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 310 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 310 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0073 \text{ g}^2/\text{Hz}$

Composite =  $14.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0058 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 270 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 270 - 450 Hz @ +12 dB/oct  
 450 - 700 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0033 \text{ g}^2/\text{Hz}$

Composite =  $10.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 48 - 48 Hz @ +9 dB/oct  
 48 - 350 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.08 \text{ g}^2/\text{Hz}$

Composite =  $22 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 48 - 48 Hz @ +10 dB/oct  
 48 - 200 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $16.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 310 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
 310 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.029 \text{ g}^2/\text{Hz}$

Composite =  $29.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +6 dB/oct  
 42 - 270 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 270 - 450 Hz @ +12 dB/oct  
 450 - 700 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $21.0 \text{ g}_{\text{rms}}$

3-1-1-1B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-1-C Input to Components mounted on Structural Rings at  $X_T$  941 and  $X_T$  897 in Panels 1, 2, and 3 of the Intertank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component  $> 75$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.028 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 310 Hz @  $0.055 \text{ g}^2/\text{Hz}$   
 310 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0035 \text{ g}^2/\text{Hz}$

Composite =  $10.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0058 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 270 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 270 - 450 Hz @ +12 dB/oct  
 450 - 700 Hz @  $0.093 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0015 \text{ g}^2/\text{Hz}$

Composite =  $7.4 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 38 Hz @ +9 dB/oct  
 38 - 350 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.04 \text{ g}^2/\text{Hz}$

Composite =  $15.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +10 dB/oct  
 40 - 200 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $11.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 310 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
 310 - 400 Hz @ +9 dB/oct  
 400 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $20.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 270 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 270 - 450 Hz @ +12 dB/oct  
 450 - 700 Hz @  $0.37 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.006 \text{ g}^2/\text{Hz}$

Composite =  $14.8 \text{ g}_{\text{rms}}$

3-1-1-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-1-AP Input to Components mounted on Structural Rings  
at  $X_T$  941 and  $X_T$  897 in Panels 1, 2 and 3 of the  
Intertank, and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
Cable Tray Installation. Weight of Component  
< 25 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.063 \text{ g}^2/\text{Hz}$   
20 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @  $0.88 \text{ g}^2/\text{Hz}$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.098 \text{ g}^2/\text{Hz}$

Composite =  $38.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0038 \text{ g}^2/\text{Hz}$   
20 - 150 Hz @ +6 dB/oct  
150 - 360 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
360 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.098 \text{ g}^2/\text{Hz}$

Composite =  $27.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +9 dB/oct  
60 - 350 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
350 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.16 \text{ g}^2/\text{Hz}$

Composite =  $31.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +10 dB/oct  
60 - 200 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
200 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.080 \text{ g}^2/\text{Hz}$

Composite =  $22.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
20 - 150 Hz @ +4 dB/oct  
150 - 540 Hz @  $3.5 \text{ g}^2/\text{Hz}$   
540 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $6.0 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.39 \text{ g}^2/\text{Hz}$

Composite =  $76.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
20 - 150 Hz @ +6 dB/oct  
150 - 360 Hz @  $0.8 \text{ g}^2/\text{Hz}$   
360 - 500 Hz @ +12 dB/oct  
500 - 1000 Hz @  $3.0 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.39 \text{ g}^2/\text{Hz}$

Composite =  $55.4 \text{ g}_{\text{rms}}$

**3-1-1-1-AP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*

5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*

5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 3-1-1-1-3P Input to Components mounted on Structural Rings at X<sub>T</sub> 941 and X<sub>T</sub> 897 in Panels 1, 2 and 3 of the Intertank, and within ±10° of the GO<sub>2</sub> Press. Line/ Cable Tray Installation. Weight of Component > 25 but < 75 lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.048 g<sup>2</sup>/Hz  
 20 - 105 Hz @ +4 dB/oct  
 105 - 540 Hz @ 0.43 g<sup>2</sup>/Hz  
 540 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.75 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 27.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.048 g<sup>2</sup>/Hz  
 20 - 105 Hz @ +6 dB/oct  
 105 - 360 Hz @ 0.1 g<sup>2</sup>/Hz  
 360 - 500 Hz @ +12 dB/oct  
 500 - 1000 Hz @ 0.38 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 19.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.011 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +9 dB/oct  
 48 - 350 Hz @ 0.15 g<sup>2</sup>/Hz  
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @ 0.5 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.08 g<sup>2</sup>/Hz

Composite = 22 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0026 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +10 dB/oct  
 48 - 200 Hz @ 0.050 g<sup>2</sup>/Hz  
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @ 0.25 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.040 g<sup>2</sup>/Hz

Composite = 16.2 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.19 g<sup>2</sup>/Hz  
 20 - 105 Hz @ +4 dB/oct  
 105 - 540 Hz @ 1.7 g<sup>2</sup>/Hz  
 540 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 3.0 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 54.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.015 g<sup>2</sup>/Hz  
 20 - 105 Hz @ +6 dB/oct  
 105 - 360 Hz @ 0.4 g<sup>2</sup>/Hz  
 360 - 500 Hz @ +12 dB/oct  
 500 - 1000 Hz @ 1.5 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 39.2 g<sub>rms</sub>

**3-1-1-1-BP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-1-1-1-CP Input to Components mounted on Structural Rings  
at X<sub>T</sub> 961 and X<sub>T</sub> 897 in Panel 1, 2 and 3 of the  
Intertank. and within ±10° of the GO<sub>2</sub> Press. Line/  
Cable Tray Installation. Weight of Component > 75  
Lbs.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0035 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +4 dB/oct  
 76 - 540 Hz @ 0.21 g<sup>2</sup>/Hz  
 540 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 0.38 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 19.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0038 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +6 dB/oct  
 76 - 300 Hz @ 0.05 g<sup>2</sup>/Hz  
 360 - 500 Hz @ +12 dB/oct  
 500 - 1000 Hz @ 0.19 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 13.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.011 g<sup>2</sup>/Hz  
 20 - 38 Hz @ +9 dB/oct  
 38 - 350 Hz @ 0.075 g<sup>2</sup>/Hz  
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @ 0.25 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.04 g<sup>2</sup>/Hz

Composite = 15.6 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0026 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +10 dB/oct  
 40 - 200 Hz @ 0.025 g<sup>2</sup>/Hz  
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @ 0.12 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.020 g<sup>2</sup>/Hz

Composite = 11.5 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.14 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +4 dB/oct  
 76 - 540 Hz @ 0.85 g<sup>2</sup>/Hz  
 540 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @ 1.5 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.1 g<sup>2</sup>/Hz

Composite = 38.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.015 g<sup>2</sup>/Hz  
 20 - 76 Hz @ +6 dB/oct  
 76 - 360 Hz @ 0.2 g<sup>2</sup>/Hz  
 360 - 500 Hz @ +12 dB/oct  
 500 - 1000 Hz @ 0.75 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.1 g<sup>2</sup>/Hz

Composite = 27.8 g<sub>rms</sub>

**3-1-1-1-CP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

**Subzone 3-1-1-2-A** Input to Components mounted on Structural Rings at  
 $X_T$  1082 and  $X_T$  1034 in Panels 1, 2 and 3 of the  
 Intertank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/Cable Tray Installation. Weight of Component  
 < 25 lbs.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +6 dB/oct  
 60 - 350 Hz @  $0.33 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $0.63 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.028 \text{ g}^2/\text{Hz}$

Composite =  $24.7 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.0083 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +6 dB/oct  
 60 - 300 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $18.3 \text{ g}_{\text{rms}}$

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +9 dB/oct  
 60 - 350 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.16 \text{ g}^2/\text{Hz}$

Composite =  $31.0 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +10 dB/oct  
 60 - 200 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.080 \text{ g}^2/\text{Hz}$

Composite =  $22.9 \text{ g}_{\text{rms}}$

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +6 dB/oct  
 60 - 350 Hz @  $1.3 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $2.5 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $49.4 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +6 dB/oct  
 60 - 300 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.06 \text{ g}^2/\text{Hz}$

Composite =  $36.5 \text{ g}_{\text{rms}}$

**3-1-1-2-A (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-1-1-2-B Input to Components Mounted on Structural Rings at  $X_T 1082 + X_T 1034$  in Panels 1, 2 and 3 of the Inter-tank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component  $\geq 25$  but  $< 75$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 350 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $17.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0083 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 300 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0075 \text{ g}^2/\text{Hz}$

Composite =  $13.2 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 48 Hz @ +9 dB/oct  
 48 - 350 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.08 \text{ g}^2/\text{Hz}$

Composite =  $22 \text{ g}_{\text{rms}}$

Long. and Tang. Axis

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 48 Hz @ +10 dB/oct  
 48 - 200 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $16.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 350 Hz @  $0.64 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $1.2 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $34.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +6 dB/oct  
 42 - 300 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.03 \text{ g}^2/\text{Hz}$

Composite =  $26.4 \text{ g}_{\text{rms}}$

**3-1-1-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 3-1-1-2-C Input to Components Mounted on Structural Rings at  
 $X_T$  1082 and  $X_T$  1034 in Panels 1, 2 and 3 of the  
 Intertank, and not within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/Cable Tray Installation. Weight of Component  
 $\geq 75$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 350 Hz @  $0.08 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0065 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0083 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0038 \text{ g}^2/\text{Hz}$

Composite =  $9.4 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 38 Hz @ +9 dB/oct  
 38 - 350 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.04 \text{ g}^2/\text{Hz}$

Composite =  $15.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +10 dB/oct  
 40 - 200 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $11.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 350 Hz @  $0.32 \text{ g}^2/\text{Hz}$   
 350 - 430 Hz @ +9 dB/oct  
 430 - 900 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.026 \text{ g}^2/\text{Hz}$

Composite =  $24.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
 20 - 30 Hz @ +6 dB/oct  
 30 - 300 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 300 - 480 Hz @ +12 dB/oct  
 480 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $18.7 \text{ g}_{\text{rms}}$

3-1-1-2-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-2-AP Input to Components Mounted on Structural Rings  
 at  $X_T$  1082 and  $X_T$  1034 in Panels 1, 2 and 3 of the  
 Intertank, and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
 Cable Tray Installation. Weight of Component <  
 25 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 60 - 60 Hz @ +6 dB/oct  
 60 - 120 Hz @  $0.33 \text{ g}^2/\text{Hz}$   
 120 - 210 Hz @ +6 dB/oct  
 210 - 400 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 400 - 480 Hz @ +9 dB/oct  
 480 - 900 Hz @  $1.75 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.078 \text{ g}^2/\text{Hz}$

Composite =  $39.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 20 - 200 Hz @ +3 dB/oct  
 200 - 300 Hz @  $0.23 \text{ g}^2/\text{Hz}$   
 300 - 500 Hz @ +12 dB/oct  
 500 - 700 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.068 \text{ g}^2/\text{Hz}$

Composite =  $31.6 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 60 - 60 Hz @ +9 dB/oct  
 60 - 350 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 350 - 500 Hz @ +10 dB/oct  
 500 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.16 \text{ g}^2/\text{Hz}$

Composite =  $31.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 60 Hz @ +10 dB/oct  
 60 - 200 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.080 \text{ g}^2/\text{Hz}$

Composite =  $22.9 \text{ g}_{\text{rms}}$

### 3-1-1-2-AP (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 - 20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
60 - 60 Hz @ +6 dB/oct  
60 - 120 Hz @  $1.3 \text{ g}^2/\text{Hz}$   
120 - 210 Hz @ +6 dB/oct  
210 - 400 Hz @  $4.0 \text{ g}^2/\text{Hz}$   
400 - 480 Hz @ +9 dB/oct  
480 - 900 Hz @  $7.0 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.31 \text{ g}^2/\text{Hz}$

Composite =  $79.0 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 - 20 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
20 - 200 Hz @ +3 dB/oct  
200 - 300 Hz @  $0.9 \text{ g}^2/\text{Hz}$   
300 - 500 Hz @ +12 dB/oct  
500 - 700 Hz @  $6.0 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.27 \text{ g}^2/\text{Hz}$

Composite =  $63.2 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-2-BP Input to Components Mounted on Structural Rings  
at  $X_T$  1082 and  $X_T$  1034 in Panels 1, 2, and 3 of  
the Intertank, and within  $\pm 10^\circ$  of the  $GO_2$  Press.  
Line/Cable Tray Installation. Weight of Component  
 $\geq 25$  but  $< 75$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
42 - 42 Hz @ +6 dB/oct  
42 - 120 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
120 - 210 Hz @ +6 dB/oct  
210 - 400 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
400 - 480 Hz @ +9 dB/oct  
480 - 900 Hz @  $0.88 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $28.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.016 \text{ g}^2/\text{Hz}$   
140 - 140 Hz @ +3 dB/oct  
140 - 300 Hz @  $0.11 \text{ g}^2/\text{Hz}$   
300 - 500 Hz @ +12 dB/oct  
500 - 700 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.035 \text{ g}^2/\text{Hz}$

Composite =  $22.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
48 - 48 Hz @ +9 dB/oct  
48 - 350 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
350 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.08 \text{ g}^2/\text{Hz}$

Composite =  $22 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
48 - 48 Hz @ +10 dB/oct  
48 - 200 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
200 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $16.2 \text{ g}_{\text{rms}}$

### 3-1-1-2-BP (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
20 - 42 Hz @ +6 dB/oct  
42 - 120 Hz @  $0.65 \text{ g}^2/\text{Hz}$   
120 - 210 Hz @ +6 dB/oct  
210 - 400 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
400 - 480 Hz @ +9 dB/oct  
480 - 900 Hz @  $3.5 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $56.5 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.064 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +3 dB/oct  
140 - 300 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
300 - 500 Hz @ +12 dB/oct  
500 - 700 Hz @  $3.0 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.14 \text{ g}^2/\text{Hz}$

Composite =  $44.9 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-1-2-CP Input to Components Mounted on Structural Rings  
at  $X_T$  1082 and  $X_T$  1034 in Panels 1, 2 and 3 of the  
Intertank, and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/  
Cable Tray Installation. Weight of Component  $\geq$   
75 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.038 g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 120 Hz @  $0.08 g^2/Hz$   
120 - 210 Hz @ +6 dB/oct  
210 - 400 Hz @  $0.25 g^2/Hz$   
400 - 480 Hz @ +9 dB/oct  
480 - 900 Hz @  $0.43 g^2/Hz$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.019 g^2/Hz$

Composite =  $19.8 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.011 g^2/Hz$   
20 - 100 Hz @ +3 dB/oct  
100 - 300 Hz @  $0.055 g^2/Hz$   
300 - 500 Hz @ +12 dB/oct  
500 - 700 Hz @  $0.38 g^2/Hz$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.018 g^2/Hz$

Composite =  $15.6 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

20 Hz @  $0.011 g^2/Hz$   
20 - 38 Hz @ +9 dB/oct  
38 - 350 Hz @  $0.075 g^2/Hz$   
350 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $0.25 g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.04 g^2/Hz$

Composite =  $15.6 g_{rms}$

20 Hz @  $0.0026 g^2/Hz$   
20 - 40 Hz @ +10 dB/oct  
40 - 200 Hz @  $0.025 g^2/Hz$   
200 - 350 Hz @ +9 dB/oct  
350 - 800 Hz @  $0.12 g^2/Hz$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.020 g^2/Hz$

Composite =  $11.5 g_{rms}$

### 3-1-1-2-CP (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 - 20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
30 - 30 Hz @ +6 dB/oct  
30 - 120 Hz @  $0.32 \text{ g}^2/\text{Hz}$   
120 - 210 Hz @ +6 dB/oct  
210 - 400 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
400 - 480 Hz @ +9 dB/oct  
480 - 900 Hz @  $1.7 \text{ g}^2/\text{Hz}$   
900 - 2000 Hz @ -12 dB/oct  
2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $39.5 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 - 20 Hz @  $0.044 \text{ g}^2/\text{Hz}$   
100 - 100 Hz @ +3 dB/oct  
100 - 300 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
300 - 500 Hz @ +12 dB/oct  
500 - 700 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.07 \text{ g}^2/\text{Hz}$

Composite =  $31.1 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



**Subzone 3-1-2      Structural Ring at Station X<sub>T</sub> 985 in Panels 1, 2, and 3 of the ET Intertank (General Specifications)**

Same as Subzone 3-1-2-A below.

**Subzone 3-1-2-A    Input to Components Mounted on Structural Ring at X<sub>T</sub> 985 in Panels 1, 2 and 3 of the Intertank, and not within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component < 30 lb.**

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.013 g<sup>2</sup>/Hz  
 20 - 60 Hz @ +6 dB/oct  
 60 - 340 Hz @ 0.11 g<sup>2</sup>/Hz  
 340 - 500 Hz @ +6 dB/oct  
 500 - 800 Hz @ 0.25 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 14.7 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0028 g<sup>2</sup>/Hz  
 20 - 60 Hz @ +6 dB/oct  
 60 - 250 Hz @ 0.025 g<sup>2</sup>/Hz  
 250 - 450 Hz @ +9 dB/oct  
 450 - 700 Hz @ 0.15 g<sup>2</sup>/Hz  
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0068 g<sup>2</sup>/Hz

Composite = 10.4 g<sub>rms</sub>

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.019 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +9 dB/oct  
 50 - 200 Hz @ 0.3 g<sup>2</sup>/Hz  
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @ 0.15 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 14.1 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 60 Hz @ +10 dB/oct  
 60 - 200 Hz @ 0.050 g<sup>2</sup>/Hz  
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @ 0.25 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.040 g<sup>2</sup>/Hz

Composite = 16.2 g<sub>rms</sub>

### 3-1-2-A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 Hz @  $0.051 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 340 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
340 - 500 Hz @ +6 dB/oct  
500 - 800 Hz @  $1.0 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.096 \text{ g}^2/\text{Hz}$

Composite =  $29.3 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +6 dB/oct  
60 - 250 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
250 - 450 Hz @ +9 dB/oct  
450 - 700 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
700 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.027 \text{ g}^2/\text{Hz}$

Composite =  $20.8 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-2-B Input to Components Mounted on Structural Ring at  $X_T$  985 in Panels 1, 2 and 3 of the Intertank, and not within  $+10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component  $\geq 30$  but  $< 90$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 43 - 43 Hz @ +6 dB/oct  
 43 - 340 Hz @  $0.058 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +6 dB/oct  
 500 - 800 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $11.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
 43 - 43 Hz @ +6 dB/oct  
 43 - 250 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 250 - 450 Hz @ +9 dB/oct  
 450 - 700 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0035 \text{ g}^2/\text{Hz}$

Composite =  $7.2 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
 40 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $10.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0013 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +10 dB/oct  
 42 - 200 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $11.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.051 \text{ g}^2/\text{Hz}$   
 43 - 43 Hz @ +6 dB/oct  
 43 - 340 Hz @  $0.23 \text{ g}^2/\text{Hz}$   
 340 - 500 Hz @ +6 dB/oct  
 500 - 800 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.048 \text{ g}^2/\text{Hz}$

Composite =  $22.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 43 - 43 Hz @ +6 dB/oct  
 43 - 250 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 250 - 450 Hz @ +9 dB/oct  
 450 - 700 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $14.4 \text{ g}_{\text{rms}}$

**3-1-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-1-2-C Input to Components Mounted on Structural Ring at X<sub>T</sub> 985 In Panels 1, 2 and 3 of the Intertank, and not within  $\pm 10^\circ$  of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component  $\geq$  90 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.013 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 340 Hz @ 0.028 g<sup>2</sup>/Hz  
 340 - 500 Hz @ +6 dB/oct  
 500 - 800 Hz @ 0.063 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.006 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.0028 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 250 Hz @ 0.0063 g<sup>2</sup>/Hz  
 250 - 450 Hz @ +9 dB/oct  
 450 - 700 Hz @ 0.038 g<sup>2</sup>/Hz  
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0018 g<sup>2</sup>/Hz

Composite = 5.1 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.019 g<sup>2</sup>/Hz  
 32 - 32 Hz @ +9 dB/oct  
 32 - 200 Hz @ 0.075 g<sup>2</sup>/Hz  
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @ 0.038 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.006 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +10 dB/oct  
 30 - 200 Hz @ 0.012 g<sup>2</sup>/Hz  
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @ 0.060 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010 g<sup>2</sup>/Hz

Composite = 8.1 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @ 0.051 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 340 Hz @ 0.11 g<sup>2</sup>/Hz  
 340 - 500 Hz @ +6 dB/oct  
 500 - 800 Hz @ 0.25 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 14.7 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.011 g<sup>2</sup>/Hz  
 30 - 30 Hz @ +6 dB/oct  
 30 - 250 Hz @ 0.025 g<sup>2</sup>/Hz  
 250 - 450 Hz @ +9 dB/oct  
 450 - 700 Hz @ 0.15 g<sup>2</sup>/Hz  
 700 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.007 g<sup>2</sup>/Hz

Composite = 10.2 g<sub>rms</sub>

3-1-2-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-2-AP Input to Components Mounted on Structural Ring at  
 $X_T$  985 in Panels 1, 2 and 3 of the Intertank, and  
 within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray  
 Installation. Weight of Component < 30 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 g^2/Hz$   
 20 - 120 Hz @ +6 dB/oct  
 120 - 500 Hz @  $0.4 g^2/Hz$   
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @  $0.75 g^2/Hz$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.048 g^2/Hz$

Composite =  $27.3 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.0028 g^2/Hz$   
 20 - 130 Hz @ +6 dB/oct  
 130 - 320 Hz @  $0.11 g^2/Hz$   
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @  $0.43 g^2/Hz$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.018 g^2/Hz$

Composite =  $18.9 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.019 g^2/Hz$   
 20 - 50 Hz @ +9 dB/oct  
 50 - 200 Hz @  $0.3 g^2/Hz$   
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @  $0.15 g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.024 g^2/Hz$

Composite =  $14.6 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.0013 g^2/Hz$   
 20 - 60 Hz @ +10 dB/oct  
 60 - 200 Hz @  $0.050 g^2/Hz$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.25 g^2/Hz$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.040 g^2/Hz$

Composite =  $16.2 g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.044 g^2/Hz$   
 20 - 120 Hz @ +6 dB/oct  
 120 - 500 Hz @  $1.6 g^2/Hz$   
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @  $3.0 g^2/Hz$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.19 g^2/Hz$

Composite =  $54.5 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.011 g^2/Hz$   
 20 - 130 Hz @ +6 dB/oct  
 130 - 320 Hz @  $0.45 g^2/Hz$   
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @  $1.7 g^2/Hz$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.07 g^2/Hz$

Composite =  $37.7 g_{rms}$

3-1-2-AP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 3-1-2-BP Input to Components Mounted on Structural Ring at  
X<sub>T</sub> 985 in Panels 1, 2 and 3 of the Intertank, and  
within  $\pm 10^\circ$  of the GO<sub>2</sub> Press. Line/Cable Tray  
Installation. Weight of Component  $\geq 30$  but  $< 90$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 86 Hz @ +6 dB/oct  
 86 - 500 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @  $0.38 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $19.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0028 \text{ g}^2/\text{Hz}$   
 20 - 94 Hz @ +6 dB/oct  
 94 - 320 Hz @  $0.058 \text{ g}^2/\text{Hz}$   
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.0088 \text{ g}^2/\text{Hz}$

Composite =  $13.2 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $10.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0013 \text{ g}^2/\text{Hz}$   
 20 - 42 Hz @ +10 dB/oct  
 42 - 200 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $11.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.044 \text{ g}^2/\text{Hz}$   
 20 - 86 Hz @ +6 dB/oct  
 86 - 500 Hz @  $0.8 \text{ g}^2/\text{Hz}$   
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @  $1.5 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.095 \text{ g}^2/\text{Hz}$

Composite =  $38.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 20 - 94 Hz @ +6 dB/oct  
 94 - 320 Hz @  $0.23 \text{ g}^2/\text{Hz}$   
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @  $0.85 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @  $0.035 \text{ g}^2/\text{Hz}$

Composite =  $26.4 \text{ g}_{\text{rms}}$

3-1-2-BP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - .5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-1-2-CP Input to Components Mounted on Structural Ring at  
X<sub>T</sub> 985 in Panels 1, 2 and 3 of the Intertank, and  
within  $\pm 10^\circ$  of the GO<sub>2</sub> Press. Line/Cable Tray  
Installation. Weight of Component  $\geq$  90 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.011 g<sup>2</sup>/Hz  
 20 - 62 Hz @ +6 dB/oct  
 62 - 500 Hz @ 0.1 g<sup>2</sup>/Hz  
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @ 0.19 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 13.8 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0028 g<sup>2</sup>/Hz  
 20 - 64 Hz @ +6 dB/oct  
 64 - 320 Hz @ 0.028 g<sup>2</sup>/Hz  
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @ 0.11 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.0045 g<sup>2</sup>/oct

Composite = 9.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.019 g<sup>2</sup>/Hz  
 20 - 32 Hz @ +9 dB/oct  
 32 - 200 Hz @ 0.075 g<sup>2</sup>/Hz  
 200 - 240 Hz @ -12 dB/oct  
 240 - 800 Hz @ 0.038 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.006 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0013 g<sup>2</sup>/Hz  
 20 - 30 Hz @ +10 dB/oct  
 30 - 200 Hz @ 0.012 g<sup>2</sup>/Hz  
 200 - 350 Hz @ +9 dB/oct  
 350 - 800 Hz @ 0.060 g<sup>2</sup>/Hz  
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.010 g<sup>2</sup>/Hz

Composite = 8.1 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.044 g<sup>2</sup>/Hz  
 20 - 62 Hz @ +6 dB/oct  
 62 - 500 Hz @ 0.4 g<sup>2</sup>/Hz  
 500 - 600 Hz @ +10 dB/oct  
 600 - 1000 Hz @ 0.75 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.048 g<sup>2</sup>/Hz

Composite = 27.5 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.011 g<sup>2</sup>/Hz  
 20 - 64 Hz @ +6 dB/oct  
 64 - 320 Hz @ 0.11 g<sup>2</sup>/Hz  
 320 - 500 Hz @ +9 dB/oct  
 500 - 900 Hz @ 0.43 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -12 dB/oct  
 2000 Hz @ 0.018 g<sup>2</sup>/Hz

Composite = 19.0 g<sub>rms</sub>

**3-1-2-CP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-2 ET Intertank (Stations  $X_T$  1130 to  $X_T$  852) Panels 4 and 5. (General Specifications)

Same as Subzone 3-2-1-A below.

Subzone 3-2-1 Structural Rings at Stations  $X_T$  1082,  $X_T$  1034,  $X_T$  941, and  $X_T$  897 in Panels 4 and 5 of the ET Intertank. (General Specifications)

Same as Subzone 3-2-1-A below.

Subzone 3-2-1-A Input to Components Mounted on Structural Rings at Stations  $X_T$  1082,  $X_T$  1034,  $X_T$  941 and  $X_T$  897, in Panels 4 and 5 of the ET Intertank. Weight of Components < 50 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.048 g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $0.75 g^2/Hz$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.075 g^2/Hz$

Composite =  $21.6 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.075 g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 200 Hz @  $0.17 g^2/Hz$   
200 - 400 Hz @ +10 dB/oct  
400 - 800 Hz @  $1.75 g^2/Hz$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.082 g^2/Hz$

Composite =  $37.6 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.009 g^2/Hz$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $0.15 g^2/Hz$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.015 g^2/Hz$

Composite =  $9.7 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.0011 g^2/Hz$   
20 - 60 Hz @ +9 dB/oct  
60 - 230 Hz @  $0.029 g^2/Hz$   
230 - 360 Hz @ +10 dB/oct  
360 - 2000 Hz @  $0.12 g^2/Hz$

Composite =  $14.8 g_{rms}$

**3-2-1-A (Cont.)**

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $3.0 \text{ g}^2/\text{Hz}$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.3 \text{ g}^2/\text{Hz}$

Composite =  $43.2 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.31 \text{ g}^2/\text{Hz}$   
20 - 30 Hz @ +6 dB/oct  
30 - 200 Hz @  $0.70 \text{ g}^2/\text{Hz}$   
200 - 400 Hz @ +10 dB/oct  
400 - 800 Hz @  $7.00 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.33 \text{ g}^2/\text{Hz}$

Composite =  $75.3 \text{ g}_{\text{rms}}$

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-2-1-B Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034,  $X_t$  941 and  $X_t$  897, in Panels 4 and 5 of the ET Intertank. Weight of Component  $\geq 50$  but  $< 150$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.048 g^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.38 g^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.038 g^2/\text{Hz}$

Composite =  $15.4 g_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.087 g^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $0.87 g^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.042 g^2/\text{Hz}$

Composite =  $26.6 g_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0096 g^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.075 g^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0075 g^2/\text{Hz}$

Composite =  $6.9 g_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0010 g^2/\text{Hz}$   
 20 - 48 Hz @ +9 dB/oct  
 48 - 230 Hz @  $0.015 g^2/\text{Hz}$   
 230 - 360 Hz @ +10 dB/oct  
 360 - 2000 Hz @  $0.062 g^2/\text{Hz}$

Composite =  $10.5 g_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.19 g^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $1.5 g^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.15 g^2/\text{Hz}$

Composite =  $30.7 g_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.35 g^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $3.50 g^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.17 g^2/\text{Hz}$

Composite =  $53.2 g_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
 5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
 5 - 40 Hz @ 0.8 G's peak

3-2-1-B (Cont.)

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 3-2-1-C Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034,  $X_t$  941 and  $X_t$  897, in Panels 4 and 5 of the ET Intertank. Weight of Components  $\geq$  150 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.048 \text{ g}^2/\text{Hz}$   
 32 - 32 Hz @ +9 dB/oct  
 200 - 200 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $0.44 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.021 \text{ g}^2/\text{Hz}$

Composite =  $18.8 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @  $0.0096 \text{ g}^2/\text{Hz}$   
 32 - 32 Hz @ +9 dB/oct  
 200 - 200 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0038 \text{ g}^2/\text{Hz}$

Composite =  $4.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 20 Hz @  $0.0010 \text{ g}^2/\text{Hz}$   
 38 - 38 Hz @ +9 dB/oct  
 230 - 230 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 360 - 360 Hz @ +10 dB/oct  
 2000 - 2000 Hz @  $0.031 \text{ g}^2/\text{Hz}$

Composite =  $7.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 32 - 32 Hz @ +9 dB/oct  
 200 - 200 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
 2000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $21.8 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $1.75 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.083 \text{ g}^2/\text{Hz}$

Composite =  $37.7 \text{ g}_{\text{rms}}$

3-2-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-2-2      Structural Ring at Station  $X_t$  985 in Panels 4 and 5 of  
the ET Intertank. (General Specifications)

Same as Subzone 3-2-2-A below.

Subzone 3-2-2-A    Input to Components Mounted on Structural Ring at  
Station  $X_t$  985 in Panels 4 and 5 of the ET Intertank.  
Weight of Components < 75 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $11.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.045 \text{ g}^2/\text{Hz}$   
200 - 400 Hz @ +10 dB/oct  
400 - 800 Hz @  $0.45 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $19.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.004 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +9 dB/oct  
60 - 230 Hz @  $0.0080 \text{ g}^2/\text{Hz}$   
230 - 360 Hz @ +10 dB/oct  
360 - 2000 Hz @  $0.035 \text{ g}^2/\text{Hz}$

Composite =  $7.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
20 - 50 Hz @ +9 dB/oct  
50 - 200 Hz @  $0.8 \text{ g}^2/\text{Hz}$   
200 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.08 \text{ g}^2/\text{Hz}$

Composite =  $22.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.09 \text{ g}^2/\text{Hz}$   
20 - 30 Hz @ +6 dB/oct  
30 - 200 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
200 - 400 Hz @ +10 dB/oct  
400 - 800 Hz @  $1.80 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.092 \text{ g}^2/\text{Hz}$

Composite =  $38.1 \text{ g}_{\text{rms}}$

**3-2-2-A (Cont.)**

**4. . Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-2-2-B Input to Components Mounted on Structural Ring at Station X<sub>t</sub> 985 in panels 4 and 5 of the ET Intertank.  
 Weight of Components  $\geq 75$  but  $< 225$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.01 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.022 \text{ g}^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $0.22 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.011 \text{ g}^2/\text{Hz}$

Composite =  $13.4 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.02 \text{ g}^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.002 \text{ g}^2/\text{Hz}$

Composite =  $3.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 48 Hz @ +9 dB/oct  
 48 - 230 Hz @  $0.0038 \text{ g}^2/\text{Hz}$   
 230 - 360 Hz @ +10 dB/oct  
 360 - 2000 Hz @  $0.018 \text{ g}^2/\text{Hz}$

Composite =  $5.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +9 dB/oct  
 40 - 200 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.04 \text{ g}^2/\text{Hz}$

Composite =  $16.0 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 200 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @  $0.90 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.046 \text{ g}^2/\text{Hz}$

Composite =  $26.8 \text{ g}_{\text{rms}}$

3-2-2-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axis

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-2-2-C Input to Components Mounted on Structural Ring at  
Station X<sub>t</sub> 985 in Panels 4 and 5 of the ET Intertank  
 Weight of Components  $\geq$  225 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.013  $g^2$ /Hz  
 20 - 32 Hz @ +9 dB/oct  
 32 - 200 Hz @ 0.05  $g^2$ /Hz  
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.005  $g^2$ /Hz

Composite = 5.7  $g_{rms}$

Long. and Tang. Axes

20 - 200 Hz @ 0.011  $g^2$ /Hz  
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @ 0.11  $g^2$ /Hz  
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @ 0.0057  $g^2$ /Hz

Composite = 9.5  $g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.0026  $g^2$ /Hz  
 20 - 32 Hz @ +9 dB/oct  
 32 - 200 Hz @ 0.01  $g^2$ /Hz  
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.001  $g^2$ /Hz

Composite = 2.5  $g_{rms}$

Long. and Tang. Axes

20 Hz @ 0.00030  $g^2$ /Hz  
 20 - 38 Hz @ +9 dB/oct  
 38 - 230 Hz @ 0.0032  $g^2$ /Hz  
 230 - 360 Hz @ +10 dB/oct  
 360 - 2000 Hz @ 0.014  $g^2$ /Hz

Composite = 5.0  $g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.05  $g^2$ /Hz  
 20 - 32 Hz @ +9 dB/oct  
 32 - 200 Hz @ 0.2  $g^2$ /Hz  
 200 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.02  $g^2$ /Hz

Composite = 11.3  $g_{rms}$

Long. and Tang. Axes

20 - 200 Hz @ 0.045  $g^2$ /Hz  
 200 - 400 Hz @ +10 dB/oct  
 400 - 800 Hz @ 0.45  $g^2$ /Hz  
 800 - 2000 Hz @ -10 dB/oct  
 2000 Hz @ 0.023  $g^2$ /Hz

Composite = 19.0  $g_{rms}$

3-2-2-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*

5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*

5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 3-2-3      SRB Beam at Station  $X_T$  985 of the ET Intertank.  
(General Specifications)

Same as Subzone 3-2-3-A below.

Subzone 3-2-3-A    Input to Components Mounted on the SRB Beam at  
Station  $X_T$  985 of the ET Intertank.

1. Acceptance Test Criteria (1 min/axis)

$X_t$  and  $Z_t$  Axes

20 Hz @  $0.0089 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +10 dB/oct  
40 - 800 Hz @  $0.089 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.0040 \text{ g}^2/\text{Hz}$

Composite =  $9.7 \text{ g}_{\text{rms}}$

$Y_t$  Axis

20 Hz @  $0.0035 \text{ g}^2/\text{Hz}$   
20 - 65 Hz @ +6 dB/oct  
65 - 330 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
330 - 500 Hz @ +9 dB/oct  
500 - 800 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.0060 \text{ g}^2/\text{Hz}$

Composite =  $9.8 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

$X_t$  and  $Z_t$  Axes

20 Hz @  $0.00077 \text{ g}^2/\text{Hz}$   
20 - 65 Hz @ +9 dB/oct  
65 - 160 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
160 - 360 Hz @ -3 dB/oct  
360 - 2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

$Y_t$  Axis

20 Hz @  $0.00064 \text{ g}^2/\text{Hz}$   
20 - 120 Hz @ +4 dB/oct  
120 - 330 Hz @  $0.0066 \text{ g}^2/\text{Hz}$   
330 - 500 Hz @ +10 dB/oct  
500 - 800 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0043 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

3-2-3-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

$X_t$  and  $Z_t$  Axes

20 Hz @  $0.035 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +10 dB/oct  
40 - 800 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.016 \text{ g}^2/\text{Hz}$

Composite =  $19.4 \text{ g}_{\text{rms}}$

$Y_t$  Axis

20 Hz @  $0.014 \text{ g}^2/\text{Hz}$   
20 - 65 Hz @ +6 dB/oct  
65 - 330 Hz @  $0.14 \text{ g}^2/\text{Hz}$   
330 - 500 Hz @ +9 dB/oct  
500 - 800 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $19.7 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 3-3 ET Intertank (Stations  $X_t$  1130 to  $X_t$  852), Panels 6, 7, and 8 (General Specifications)

Same as Subzone 3-3-1-A below.

Subzone 3-3-1 Structural Rings at Stations  $X_t$  1082,  $X_t$  1034 (Partial),  $X_t$  941, and  $X_t$  897 in Panels 6, 7, and 8 of the ET Intertank (General Specifications)

Same as Subzone 3-3-1-A below.

Subzone 3-3-1-A Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034 (Partial),  $X_t$  941 and  $X_t$  897 in Panels 6, 7, and 8 of the ET Intertank. Weight of Component < 25 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.024 g^2/Hz$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @  $0.38 g^2/Hz$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.15 g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.019 g^2/Hz$

Composite =  $14.8 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.038 g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @  $0.075 g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.019 g^2/Hz$

Composite =  $10.5 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.095 g^2/Hz$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @  $1.5 g^2/Hz$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.6 g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.075 g^2/Hz$

Composite =  $29.6 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.15 g^2/Hz$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @  $0.3 g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.075 g^2/Hz$

Composite =  $21.0 g_{rms}$

### 3-3-1-A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @  $1.2 \text{ g}^2/\text{Hz}$   
100 - 130 Hz @ -12 dB/oct  
130 - 1000 Hz @  $0.42 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.17 \text{ g}^2/\text{Hz}$

Composite =  $26.7 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.08 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +3 dB/oct  
60 - 1000 Hz @  $0.24 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $17.7 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's Peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria

See Table I

\* Design Criteria Only

**Subzone 3-3-1-B** Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034 (Partial),  $X_t$  941 and  $X_t$  897 on Panels 6, 7, and 8 of the ET Intertank. Weight of Component  $\geq 25$  but  $< 75$  lb.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 - 20 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 28 - 28 Hz @ +12 dB/oct  
 28 - 100 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0095 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 - 20 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 40 - 40 Hz @ +3 dB/oct  
 40 - 1000 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0095 \text{ g}^2/\text{Hz}$

Composite =  $11.4 \text{ g}_{\text{rms}}$

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 - 20 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 28 - 28 Hz @ +12 dB/oct  
 28 - 100 Hz @  $0.75 \text{ g}^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $21.1 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 - 20 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 40 - 40 Hz @ +3 dB/oct  
 40 - 1000 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $22.7 \text{ g}_{\text{rms}}$

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 - 20 Hz @  $0.16 \text{ g}^2/\text{Hz}$   
 28 - 28 Hz @ +12 dB/oct  
 28 - 100 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
 130 - 130 Hz @ -12 dB/oct  
 130 - 1000 Hz @  $0.21 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -4 dB/oct  
 2000 Hz @  $0.085 \text{ g}^2/\text{Hz}$

Composite =  $19.0 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 - 20 Hz @  $0.058 \text{ g}^2/\text{Hz}$   
 42 - 42 Hz @ +3 dB/oct  
 42 - 1000 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.012 \text{ g}^2/\text{Hz}$

Composite =  $12.6 \text{ g}_{\text{rms}}$

**3-3-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 3-3-1-C Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034 (Partial),  $X_t$  941, and  $X_t$  897 in Panels 6, 7, and 8 of the ET Intertank. Weight of Component  $\geq 75$  lb. but  $< 225$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.095 g^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.038 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0048 g^2/\text{Hz}$

Composite =  $7.5 g_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.019 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0048 g^2/\text{Hz}$

Composite =  $5.3 g_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.38 g^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.15 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.019 g^2/\text{Hz}$

Composite =  $15.0 g_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.075 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.019 g^2/\text{Hz}$

Composite =  $10.5 g_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 100 Hz @  $0.3 g^2/\text{Hz}$   
 100 - 130 Hz @ -12 dB/oct  
 130 - 1000 Hz @  $0.115 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -4 dB/oct  
 2000 Hz @  $0.043 g^2/\text{Hz}$

Composite =  $14.7 g_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.06 g^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.006 g^2/\text{Hz}$

Composite =  $8.9 g_{\text{rms}}$

**3-3-1-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



Subzone 3-3-1-D Input to Components Mounted on Structural Rings at Stations  $X_t$  1082,  $X_t$  1034 (Partial),  $X_t$  941, and  $X_t$  897 in Panels 6, 7, and 8 of the ET Intertank. Weight of Component  $\leq$  225 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.048 \text{ g}^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.019 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0024 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.0095 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0024 \text{ g}^2/\text{Hz}$

Composite =  $3.8 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.19 \text{ g}^2/\text{Hz}$   
 100 - 125 Hz @ -12 dB/oct  
 125 - 1000 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.0095 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0095 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 100 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 100 - 130 Hz @ -12 dB/oct  
 130 - 1000 Hz @  $0.059 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -4 dB/oct  
 2000 Hz @  $0.022 \text{ g}^2/\text{Hz}$

Composite =  $10.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.03 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -10 dB/oct  
 2000 Hz @  $0.0003 \text{ g}^2/\text{Hz}$

Composite =  $6.5 \text{ g}_{\text{rms}}$

3-3-1-D (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's Peak\*  
5 - 40 Hz @ 0.6 G's Peak

Lateral Axes

2 - 5 Hz @ 0.8 G's Peak\*  
5 - 40 Hz @ 0.8 G's Peak

5. Shock Test Criteria

See Table I

\* Design Criteria Only

Subzone 3-3-2      Structural Ring at Station  $X_t$  985 in Panels 6, 7, and 8 of the ET Intertank. (General Specifications)

Same as Subzone 3-3-2-A below.

Subzone 3-3-2-A    Input to Components Mounted on the Structural Ring at Station  $X_t$  985 in Panels 6, 7, and 8 of the ET Intertank. Weight of Component < 35 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0078 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0063 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0063 \text{ g}^2/\text{Hz}$

Composite =  $6.1 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.031 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @  $0.5 \text{ g}^2/\text{Hz}$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $17.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 1000 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

### 3-3-2-A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 Hz @ 0.025  $g^2/Hz$   
20 - 40 Hz @ +12 dB/oct  
40 - 100 Hz @ 0.4  $g^2/Hz$   
100 - 130 Hz @ -12 dB/oct  
130 - 1000 Hz @ 0.15  $g^2/Hz$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @ 0.06  $g^2/Hz$

Composite = 16.0  $g_{rms}$

##### Long. and Tang. Axes

20 Hz @ 0.027  $g^2/Hz$   
20 - 60 Hz @ +3 dB/oct  
60 - 1100 Hz @ 0.08  $g^2/Hz$   
1100 - 2000 Hz @ -10 dB/oct  
2000 Hz @ 0.012  $g^2/Hz$

Composite = 10.6  $g_{rms}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's Peak\*  
5 - 40 Hz @ 0.6 G's Peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's Peak\*  
5 - 40 Hz @ 0.8 G's Peak

#### 5. Shock Test Criteria

See Table I

\* Design Criteria Only.

Subzone 3-3-2-B Input to Components Mounted on the Structural Ring  
at Station X<sub>t</sub> 985 in Panels 6, 7, and 8 of the ET  
Intertank. Weight of Component  $\geq 35$  but  $< 100$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0076 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +12 dB/oct  
34 - 100 Hz @  $0.063 \text{ g}^2/\text{Hz}$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0031 \text{ g}^2/\text{Hz}$

Composite =  $6.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0031 \text{ g}^2/\text{Hz}$

Composite =  $4.3 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.031 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +12 dB/oct  
34 - 100 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
100 - 125 Hz @ -12 dB/oct  
125 - 1000 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0125 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 - 1000 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0125 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
20 - 34 Hz @ +12 dB/oct  
34 - 100 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
100 - 130 Hz @ -12 dB/oct  
130 - 1000 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -4 dB/oct  
2000 Hz @  $0.03 \text{ g}^2/\text{Hz}$

Composite =  $11.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.027 \text{ g}^2/\text{Hz}$   
20 - 30 Hz @ +3 dB/oct  
30 - 1100 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
1100 - 2000 Hz @ -10 dB/oct  
2000 Hz @  $0.006 \text{ g}^2/\text{Hz}$

Composite =  $7.5 \text{ g}_{\text{rms}}$

3-3-2-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

- 2 - 5 Hz @ 0.6 G's Peak\*
- 5 - 40 Hz @ 0.6 G's Peak

Lateral Axes

- 2 - 5 Hz @ 0.8 G's Peak\*
- 5 - 40 Hz @ 0.8 G's Peak

5. Shock Test Criteria

See Table I

\* Design Criteria Only

Subzone 3-3-2-C Input to Components Mounted on the Structural Ring  
at Station X<sub>1</sub> 985 in Panels 6, 7, and 8 of the ET  
Intertank. Weight of Component  $\geq$  100 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis	Long. and Tang. Axes
20 - 20 Hz @ 0.0078 g <sup>2</sup> /Hz	20 - 1000 Hz @ 0.0063 g <sup>2</sup> /Hz
28 - 28 Hz @ +12 dB/oct	1000 - 2000 Hz @ -6 dB/oct
28 - 100 Hz @ 0.031 g <sup>2</sup> /Hz	2000 Hz @ 0.0016 g <sup>2</sup> /Hz
100 - 125 Hz @ -12 dB/oct	
125 - 1000 Hz @ 0.013 g <sup>2</sup> /Hz	
1000 - 2000 Hz @ -9 dB/oct	
2000 Hz @ 0.0016 g <sup>2</sup> /Hz	
Composite = 4.3 g <sub>rms</sub>	Composite = 3.1 g <sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis	Long. and Tang. Axes
20 - 20 Hz @ 0.031 g <sup>2</sup> /Hz	20 - 1000 Hz @ 0.025 g <sup>2</sup> /Hz
28 - 28 Hz @ +12 dB/oct	1000 - 2000 Hz @ -6 dB/oct
28 - 100 Hz @ 0.125 g <sup>2</sup> /Hz	2000 Hz @ 0.0063 g <sup>2</sup> /Hz
100 - 125 Hz @ -12 dB/oct	
125 - 1000 Hz @ 0.05 g <sup>2</sup> /Hz	
1000 - 2000 Hz @ -9 dB/oct	
2000 Hz @ 0.0063 g <sup>2</sup> /Hz	
Composite = 8.6 g <sub>rms</sub>	Composite = 6.1 g <sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis	Long. and Tang. Axes
20 - 20 Hz @ 0.025 g <sup>2</sup> /Hz	20 - 1100 Hz @ 0.02 g <sup>2</sup> /Hz
28 - 28 Hz @ +12 dB/oct	1100 - 2000 Hz @ -10 dB/oct
28 - 100 Hz @ 0.1 g <sup>2</sup> /Hz	2000 Hz @ 0.003 g <sup>2</sup> /Hz
100 - 130 Hz @ -12 dB/oct	
130 - 1000 Hz @ 0.038 g <sup>2</sup> /Hz	
1000 - 2000 Hz @ -4 dB/oct	
2000 Hz @ 0.015 g <sup>2</sup> /Hz	
Composite = 8.2 g <sub>rms</sub>	Composite = 5.3 g <sub>rms</sub>

**3-3-2-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only



**Subzone 3-3-3      Structural Ring at Station  $X_t$  1034 Between the -Z Axis and the Access Door of the ET Intertank. (General Specifications)**

Same as Subzone 3-3-3-A below.

**Subzone 3-3-3-A    Input to Components Mounted on the Structural Ring at Station  $X_t$  1034 between the -Z Axis and the Access Door of the ET Intertank. Weight of Component < 30 lb.**

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @  $0.0625 \text{ g}^2/\text{Hz}$   
 20 - 65 Hz @ +9 dB/oct  
 65 - 90 Hz @  $2.0 \text{ g}^2/\text{Hz}$   
 90 - 123 Hz @ -9 dB/oct  
 123 - 400 Hz @  $0.7 \text{ g}^2/\text{Hz}$   
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0275 \text{ g}^2/\text{Hz}$

Composite =  $23.4 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.00065 \text{ g}^2/\text{Hz}$   
 20 - 95 Hz @ +9 dB/oct  
 95 - 1300 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $10.6 \text{ g}_{\text{rms}}$

**2 & 3. Flight Random Vibration Criteria (Lift-off and Boost) (3 min/axis)**

**Radial Axis**

20 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
 20 - 65 Hz @ +9 dB/oct  
 65 - 90 Hz @  $3.0 \text{ g}^2/\text{Hz}$   
 90 - 123 Hz @ -9 dB/oct  
 123 - 400 Hz @  $2.8 \text{ g}^2/\text{Hz}$   
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $46.8 \text{ g}_{\text{rms}}$

**Long. and Tang. Axes**

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
 20 - 95 Hz @ +9 dB/oct  
 95 - 1300 Hz @  $0.28 \text{ g}^2/\text{Hz}$   
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @  $0.076 \text{ g}^2/\text{Hz}$

Composite =  $21.2 \text{ g}_{\text{rms}}$

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
 5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
 5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria**

See Table I

\* Design Criteria Only.

**Subzone 3-3-3-B** Input to Components Mounted on the Structural Ring  
at Station X<sub>t</sub> 1034 Between the -Z Axis and the Access  
Door of the ET Intertank. Weight of Component >  
30 but < 90 lb.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.065 g<sup>2</sup>/Hz  
 20 - 52 Hz @ +9 dB/oct  
 52 - 90 Hz @ 1.0 g<sup>2</sup>/Hz  
 90 - 123 Hz @ -9 dB/oct  
 123 - 480 Hz @ 0.35 g<sup>2</sup>/Hz  
 480 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.014 g<sup>2</sup>/Hz

Composite = 16.8 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.00065  
 20 - 75 Hz @ +9 dB/oct  
 75 - 1300 Hz @ 0.035  
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0095

Composite = 7.6 g<sub>rms</sub>

**2 & 3. Flight Random Vibration Criteria (Lift-off and Boost (3 min/axis))**

**Radial Axis**

20 Hz @ 0.25 g<sup>2</sup>/Hz  
 20 - 52 Hz @ +9 dB/oct  
 52 - 90 Hz @ 4.0 g<sup>2</sup>/Hz  
 90 - 123 Hz @ -9 dB/oct  
 123 - 400 Hz @ 1.4 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.056 g<sup>2</sup>/Hz

Composite = 33.7 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0026 g<sup>2</sup>/Hz  
 20 - 75 Hz @ +9 dB/oct  
 75 - 1300 Hz @ 0.14 g<sup>2</sup>/Hz  
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.038 g<sup>2</sup>/Hz

Composite = 15.1 g<sub>rms</sub>

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
 5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
 5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria**

See Table I

\* Design Criteria Only

Subzone 3-3-3-C Input to Components Mounted on the Structural Ring  
at Station X<sub>t</sub> 1034 Between the -Z Axis and the Access  
Door of the ET Intertank. Weight of Component ≥  
90 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.065 g<sup>2</sup>/Hz  
 40 - 40 Hz @ +9 dB/oct  
 40 - 90 Hz @ 0.5 g<sup>2</sup>/Hz  
 90 - 123 Hz @ -9 dB/oct  
 123 - 400 Hz @ 0.175 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.007 g<sup>2</sup>/Hz

Composite = 12.1 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.00065 g<sup>2</sup>/Hz  
 60 - 60 Hz @ +9 dB/oct  
 60 - 1300 Hz @ 0.018 g<sup>2</sup>/Hz  
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0048 g<sup>2</sup>/Hz

Composite = 5.3 g<sub>rms</sub>

2 & 3. Flight Random Vibration Criteria (Lift-off and Boost) (3 min/axis)

Radial Axis

20 - 20 Hz @ 0.25 g<sup>2</sup>/Hz  
 40 - 40 Hz @ +9 dB/oct  
 40 - 90 Hz @ 2.0 g<sup>2</sup>/Hz  
 90 - 123 Hz @ -9 dB/oct  
 123 - 400 Hz @ 0.7 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.028 g<sup>2</sup>/Hz

Composite = 24.2 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.0026 g<sup>2</sup>/Hz  
 60 - 60 Hz @ +9 dB/oct  
 60 - 1300 Hz @ 0.07 g<sup>2</sup>/Hz  
 1300 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.019 g<sup>2</sup>/Hz

Composite = 10.7 g<sub>rms</sub>

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
 5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
 5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria

See Table I

\* Design Criteria Only

**Subzone 3-4 ET LH<sub>2</sub> Forward Bulkhead (General Specifications)**

Same as Subzone 3-4-1-A below.

**Subzone 3-4-1 ET LH<sub>2</sub> Forward Bulkhead Gores (Stations X<sub>t</sub> 1130 to X<sub>t</sub> 1108). (General Specifications)**

Same as Subzone 3-4-1-A below.

**Subzone 3-4-1-A Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Gores (Stations X<sub>t</sub> 1130 to X<sub>t</sub> 1008). Weight of Component < 10 lb.**

**1. Acceptance Test Criteria (1 min/axis)**

**Direction A**

20 Hz @ 0.0022 g<sup>2</sup>/Hz  
20 - 140 Hz @ +9 dB/oct  
140 - 500 Hz @ 0.75 g<sup>2</sup>/Hz  
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.047 g<sup>2</sup>/Hz

Composite = 24.0 g<sub>rms</sub>

**Directions B and C**

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
20 - 60 Hz @ +3 dB/oct  
60 - 220 Hz @ 0.015 g<sup>2</sup>/Hz  
220 - 400 Hz @ +6 dB/oct  
400 - 900 Hz @ 0.050 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0045 g<sup>2</sup>/Hz

Composite = 7.1 g<sub>rms</sub>

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Direction A**

20 Hz @ 0.0090 g<sup>2</sup>/Hz  
20 - 140 Hz @ +9 dB/oct  
140 - 400 Hz @ 2.80 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.11 g<sup>2</sup>/Hz

Composite = 41.5 g<sub>rms</sub>

**Directions B and C**

20 - 180 Hz @ 0.050 g<sup>2</sup>/Hz  
180 - 400 Hz @ +6 dB/oct  
400 - 900 Hz @ 0.25 g<sup>2</sup>/Hz  
900 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.021 g<sup>2</sup>/Hz

Composite = 16.0 g<sub>rms</sub>

**3-4-1-A (Cont.)**

**3. Boost Random Vibration Criteria (2 min/axis)**

**Direction A**

20 Hz @ 0.0090  $g^2/Hz$   
20 - 140 Hz @ +9 dB/oct  
140 - 500 Hz @ 3.00  $g^2/Hz$   
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.19  $g^2/Hz$

Composite = 48.1  $g_{rms}$

**Directions B and C**

20 Hz @ 0.020  $g^2/Hz$   
20 - 60 Hz @ +3 dB/oct  
60 - 220 Hz @ 0.060  $g^2/Hz$   
220 - 400 Hz @ +6 dB/oct  
400 - 900 Hz @ 0.20  $g^2/Hz$   
900 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.018  $g^2/Hz$

Composite = 14.2  $g_{rms}$

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

Not Applicable

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-4-1-B Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Gores (Stations X<sub>t</sub> 1130 to X<sub>t</sub> 1008). Weight of Component  $\geq 10$  but  $< 30$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0022 g<sup>2</sup>/Hz  
 20 - 112 Hz @ +9 dB/oct  
 112 - 500 Hz @ 0.37 g<sup>2</sup>/Hz  
 500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 17.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0032 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +3 dB/oct  
 48 - 220 Hz @ 0.0075 g<sup>2</sup>/Hz  
 220 - 400 Hz @ +6 dB/oct  
 400 - 900 Hz @ 0.025 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0023 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.0090 g<sup>2</sup>/Hz  
 20 - 110 Hz @ +9 dB/oct  
 110 - 400 Hz @ 1.40 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.055 g<sup>2</sup>/Hz

Composite = 29.9 g<sub>rms</sub>

Directions B and C

20 - 180 Hz @ 0.025 g<sup>2</sup>/Hz  
 180 - 400 Hz @ +6 dB/oct  
 400 - 900 Hz @ 0.12 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 11.3 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.0090 g<sup>2</sup>/Hz  
 20 - 112 Hz @ +9 dB/oct  
 112 - 500 Hz @ 1.50 g<sup>2</sup>/Hz  
 500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.095 g<sup>2</sup>/Hz

Composite = 35.2 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.013 g<sup>2</sup>/Hz  
 20 - 48 Hz @ +3 dB/oct  
 48 - 220 Hz @ 0.030 g<sup>2</sup>/Hz  
 220 - 400 Hz @ +6 dB/oct  
 400 - 900 Hz @ 0.10 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0092 g<sup>2</sup>/Hz

Composite = 10.1 g<sub>rms</sub>

**3-4-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

**Not Applicable**

**Direction A - Perpendicular to Bulkhead**

**Direction B - Tangential to Bulkhead**

**Direction C - Tangential to Bulkhead, Perpendicular to Direction B**

**\* Design Criteria Only**

Subzone 3-4-1-C Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Gores (Stations X<sub>t</sub> 1130 to X<sub>t</sub> 1008). Weight of Components  $\geq$  30 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 - 20 Hz @ 0.0022 g<sup>2</sup>/Hz  
 88 - 88 Hz @ +9 dB/oct  
 500 - 500 Hz @ 0.19 g<sup>2</sup>/Hz  
 2000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 12.3 g<sub>rms</sub>

Directions B and C

20 - 20 Hz @ 0.0019 g<sup>2</sup>/Hz  
 38 - 38 Hz @ +3 dB/oct  
 220 - 220 Hz @ 0.0037 g<sup>2</sup>/Hz  
 400 - 400 Hz @ +6 dB/oct  
 900 - 900 Hz @ 0.012 g<sup>2</sup>/Hz  
 2000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0011 g<sup>2</sup>/Hz

Composite = 3.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 - 20 Hz @ 0.0090 g<sup>2</sup>/Hz  
 87 - 87 Hz @ +9 dB/oct  
 400 - 400 Hz @ 0.70 g<sup>2</sup>/Hz  
 2000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0027 g<sup>2</sup>/Hz

Composite = 21.1 g<sub>rms</sub>

Directions B and C

20 - 180 Hz @ 0.012 g<sup>2</sup>/Hz  
 180 - 400 Hz @ +6 dB/oct  
 400 - 900 Hz @ 0.060 g<sup>2</sup>/Hz  
 900 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.011 g<sup>2</sup>/Hz

Composite = 8.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 - 20 Hz @ 0.0090 g<sup>2</sup>/Hz  
 88 - 88 Hz @ +9 dB/oct  
 500 - 500 Hz @ 0.75 g<sup>2</sup>/Hz  
 2000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.047 g<sup>2</sup>/Hz

Composite = 24.7 g<sub>rms</sub>

Directions B and C

20 - 20 Hz @ 0.0079 g<sup>2</sup>/Hz  
 38 - 38 Hz @ +3 dB/oct  
 220 - 220 Hz @ 0.015 g<sup>2</sup>/Hz  
 400 - 400 Hz @ +6 dB/oct  
 900 - 900 Hz @ 0.050 g<sup>2</sup>/Hz  
 2000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0046 g<sup>2</sup>/Hz

Composite = 7.2 g<sub>rms</sub>



3-4-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-4-2 ET LH<sub>2</sub> Forward Bulkhead Cap (Station X<sub>t</sub> 1008).  
(General Specifications)

Same as Subzone 3-4-2-A below.

Subzone 3-4-2-A Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Cap (Station X<sub>t</sub> 1008). Weight of Component < 20 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.00078 g<sup>2</sup>/Hz  
20 - 120 Hz @ +10 dB/oct  
120 - 400 Hz @ 0.30 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 13.7 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0073 g<sup>2</sup>/Hz  
20 - 70 Hz @ +3 dB/oct  
70 - 100 Hz @ 0.023 g<sup>2</sup>/Hz  
100 - 126 Hz @ -12 dB/oct  
126 - 1000 Hz @ 0.01 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.0013 g<sup>2</sup>/Hz

Composite = 3.8 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
20 - 140 Hz @ +9 dB/oct  
140 - 400 Hz @ 1.20 g<sup>2</sup>/Hz  
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.045 g<sup>2</sup>/Hz

Composite = 27.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.029 g<sup>2</sup>/Hz  
20 - 70 Hz @ +3 dB/oct  
70 - 100 Hz @ 0.1 g<sup>2</sup>/Hz  
100 - 126 Hz @ -12 dB/oct  
126 - 1000 Hz @ 0.04 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.005 g<sup>2</sup>/Hz

Composite = 7.6 g<sub>rms</sub>

### 3.4-2-A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Direction A

20 Hz @ 0.0031  $g^2/Hz$   
20 - 120 Hz @ +10 dB/oct  
120 - 400 Hz @ 1.20  $g^2/Hz$   
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.049  $g^2/Hz$

Composite = 27.5  $g_{rms}$

##### Directions B and C

20 Hz @ 0.029  $g^2/Hz$   
20 - 70 Hz @ +3 dB/oct  
70 - 100 Hz @ 0.1  $g^2/Hz$   
100 - 126 Hz @ -12 dB/oct  
126 - 1000 Hz @ 0.04  $g^2/Hz$   
1000 - 2000 Hz @ -9 dB/oct  
2000 Hz @ 0.005  $g^2/Hz$

Composite = 7.6  $g_{rms}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-4-2-B Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Cap (Station X<sub>t</sub> 1008). Weight of Component  $\geq 20$  but  $< 60$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.00078 g<sup>2</sup>/Hz  
 20 - 98 Hz @ +10 dB/oct  
 98 - 400 Hz @ 0.15 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0060 g<sup>2</sup>/Hz

Composite = 9.8 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.005 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +3 dB/oct  
 50 - 100 Hz @ 0.013 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.005 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.00063 g<sup>2</sup>/Hz

Composite = 2.7 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
 20 - 110 Hz @ +9 dB/oct  
 110 - 400 Hz @ 0.60 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.023 g<sup>2</sup>/Hz

Composite = 19.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.02 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +3 dB/oct  
 50 - 100 Hz @ 0.05 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.02 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0025 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.0031 g<sup>2</sup>/Hz  
 20 - 98 Hz @ +10 dB/oct  
 98 - 400 Hz @ 0.60 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.024 g<sup>2</sup>/Hz

Composite = 19.7 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.02 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +3 dB/oct  
 50 - 100 Hz @ 0.05 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.02 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0025 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

**3-4-2-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

**Not Applicable**

**Direction A - Perpendicular to Bulkhead**

**Direction B - Tangential to Bulkhead**

**Direction C - Tangential to Bulkhead, Perpendicular to Direction B**

**\* Design Criteria Only**

Subzone 3-4-2-C Input to Components Mounted on the ET LH<sub>2</sub> Forward Bulkhead Cap (Station X<sub>t</sub> 1008). Weight of Component ≥ 60 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.00078 g<sup>2</sup>/Hz  
 20 - 80 Hz @ +10 dB/oct  
 80 - 400 Hz @ 0.075 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0030 g<sup>2</sup>/Hz

Composite = 7.2 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0035 g<sup>2</sup>/Hz  
 20 - 35 Hz @ +3 dB/oct  
 35 - 100 Hz @ 0.0063 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.0025 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.00033 g<sup>2</sup>/Hz

Composite = 1.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
 20 - 90 Hz @ +9 dB/oct  
 90 - 400 Hz @ 0.30 g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 14.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.014 g<sup>2</sup>/Hz  
 20 - 35 Hz @ +3 dB/oct  
 35 - 100 Hz @ 0.025 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.01 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0013 g<sup>2</sup>/Hz

Composite = 3.8 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.0031 g<sup>2</sup>/Hz  
 20 - 80 Hz @ +10 dB/oct  
 80 - 400 Hz @ 0. g<sup>2</sup>/Hz  
 400 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 14.4 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.014 g<sup>2</sup>/Hz  
 20 - 35 Hz @ +3 dB/oct  
 35 - 100 Hz @ 0.025 g<sup>2</sup>/Hz  
 100 - 126 Hz @ -12 dB/oct  
 126 - 1000 Hz @ 0.01 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0013 g<sup>2</sup>/Hz

Composite = 3.8 g<sub>rms</sub>

**Subzone 3-4-2-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

**Not Applicable**

**Direction A — Perpendicular to Bulkhead**

**Direction B — Tangential to Bulkhead**

**Direction C — Tangential to Bulkhead, Perpendicular to Direction B**

**\* Design Criteria Only**

Subzone 3-5 ET LO<sub>2</sub> Aft Bulkhead. (General Specifications)

Same as Subzone 3-5-1-A below.

Subzone 3-5-1 ET LO<sub>2</sub> Aft Bulkhead Gores. (Stations X<sub>t</sub> 963 to X<sub>t</sub> 854). (General Specifications)

Same as Subzone 3-5-1-A below.

Subzone 3-5-1-A Input to Components Mounted on the ET LO<sub>2</sub> Aft Bulkhead Gores (Stations X<sub>t</sub> 963 to X<sub>t</sub> 854). Weight of Components < 12 lb.

1. Acceptance Test Criteria ( 1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 180 Hz @ 0.12 g<sup>2</sup>/Hz  
180 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0010 g<sup>2</sup>/Hz

Composite = 5.9 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00080 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 410 Hz @ 0.020 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00085 g<sup>2</sup>/Hz

Composite = 3.6 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 240 Hz @ 0.40 g<sup>2</sup>/Hz  
240 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.0029 g<sup>2</sup>/Hz

Composite = 11.7 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0032 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 410 Hz @ 0.080 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0034 g<sup>2</sup>/Hz

Composite = 7.3 g<sub>rms</sub>



3-5-1-A (Cont.)

3. Boost andom Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 180 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
180 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0041 \text{ g}^2/\text{Hz}$

Composite =  $11.8 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00040 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +10 dB/oct  
100 - 160 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
160 - 195 Hz @ -10 dB/oct  
195 - 600 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0036 \text{ g}^2/\text{Hz}$

Composite =  $6.5 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-5-1-B Input to Components Mounted on the ET LO<sub>2</sub> Aft Bulk-head Gores (Stations X<sub>t</sub> 963 to X<sub>t</sub> 854). Weight of Components  $\geq 12$  but  $< 36$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
 20 - 71 Hz @ +6 dB/oct  
 71 - 180 Hz @ 0.062 g<sup>2</sup>/Hz  
 180 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00052 g<sup>2</sup>/Hz

Composite = 4.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00080 g<sup>2</sup>/Hz  
 20 - 72 Hz @ +6 dB/oct  
 72 - 410 Hz @ 0.010 g<sup>2</sup>/Hz  
 410 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00042 g<sup>2</sup>/Hz

Composite = 2.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 72 Hz @ +6 dB/oct  
 72 - 240 Hz @ 0.20 g<sup>2</sup>/Hz  
 240 - 2000 Hz @ -7 dB/oct  
 2000 Hz @ 0.0014 g<sup>2</sup>/Hz

Composite = 8.5 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0032 g<sup>2</sup>/Hz  
 20 - 72 Hz @ +6 dB/oct  
 72 - 410 Hz @ 0.040 g<sup>2</sup>/Hz  
 410 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0017 g<sup>2</sup>/Hz

Composite = 5.2 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.020 g<sup>2</sup>/Hz  
 20 - 71 Hz @ +6 dB/oct  
 71 - 180 Hz @ 0.25 g<sup>2</sup>/Hz  
 180 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0021 g<sup>2</sup>/Hz

Composite = 8.6 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00024 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +10 dB/oct  
 100 - 160 Hz @ 0.048 g<sup>2</sup>/Hz  
 160 - 195 Hz @ -10 dB/oct  
 195 - 600 Hz @ 0.024 g<sup>2</sup>/Hz  
 600 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0022 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

**3-5-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

Direction A — Perpendicular to Bulkhead

Direction B — Tangential to Bulkhead

Direction C — Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-5-1-C Input to Components Mounted on the ET LO<sub>2</sub> Aft Bulkhead Gores (Stations X<sub>t</sub> 963 to X<sub>t</sub> 854). Weight of Component  $\geq$  36 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.0050 g<sup>2</sup>/Hz  
20 - 50 Hz @ +6 dB/oct  
50 - 180 Hz @ 0.032 g<sup>2</sup>/Hz  
180 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00027 g<sup>2</sup>/Hz

Composite = 3.2 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.000060 g<sup>2</sup>/Hz  
20 - 100 Hz @ +10 dB/oct  
100 - 160 Hz @ 0.012 g<sup>2</sup>/Hz  
160 - 195 Hz @ -10 dB/oct  
195 - 600 Hz @ 0.0060 g<sup>2</sup>/Hz  
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00055 g<sup>2</sup>/Hz

Composite = 2.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 50 Hz @ +6 dB/oct  
50 - 240 Hz @ 0.10 g<sup>2</sup>/Hz  
240 - 2000 Hz @ -7 dB/oct  
2000 Hz @ 0.00072 g<sup>2</sup>/Hz

Composite = 6.1 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0032 g<sup>2</sup>/Hz  
20 - 70 Hz @ +6 dB/oct  
70 - 410 Hz @ 0.039 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0015 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.020 g<sup>2</sup>/Hz  
20 - 50 Hz @ +6 dB/oct  
50 - 180 Hz @ 0.13 g<sup>2</sup>/Hz  
180 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0011 g<sup>2</sup>/Hz

Composite = 6.4 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00024 g<sup>2</sup>/Hz  
20 - 100 Hz @ +10 dB/oct  
100 - 160 Hz @ 0.048 g<sup>2</sup>/Hz  
160 - 195 Hz @ -10 dB/oct  
195 - 600 Hz @ 0.024 g<sup>2</sup>/Hz  
600 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0022 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

3-5-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.3 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-5-2 ET LO<sub>2</sub> Aft Bulkhead Cap at Station X<sub>t</sub> 854. (General Specifications)

Same as Subzone 3-5-2-A below.

Subzone 3-5-2-A Input to Components Mounted on the ET LO<sub>2</sub> Aft Bulkhead Cap at Station X<sub>t</sub> 854. Weight of Components < 50 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.004 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 250 Hz @ 0.1 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0016 g<sup>2</sup>/Hz

Composite = 6.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00055 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 410 Hz @ 0.014 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00060 g<sup>2</sup>/Hz

Composite = 3.0 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 250 Hz @ 0.4 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0063 g<sup>2</sup>/Hz

Composite = 12.7 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0022 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 410 Hz @ 0.056 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0024 g<sup>2</sup>/Hz

Composite = 6.1 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 250 Hz @ 0.4 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0063 g<sup>2</sup>/Hz

Composite = 12.7 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00048 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 160 Hz @ 0.060 g<sup>2</sup>/Hz  
160 - 200 Hz @ -9 dB/oct  
200 - 500 Hz @ 0.030 g<sup>2</sup>/Hz  
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0019 g<sup>2</sup>/Hz

Composite = 5.2 g<sub>rms</sub>

3-5-2-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-5-2-B Input to Components Mounted on the ET LO<sub>2</sub> Aft  
Bulkhead Cap at Station X<sub>t</sub> 854. Weight of Components  
≥ 50 but < 150 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.004 g<sup>2</sup>/Hz  
20 - 71 Hz @ +6 dB/oct  
71 - 250 Hz @ 0.05 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00078 g<sup>2</sup>/Hz

Composite = 4.5 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00055 g<sup>2</sup>/Hz  
20 - 84 Hz @ +6 dB/oct  
84 - 410 Hz @ 0.0095 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.00047 g<sup>2</sup>/Hz

Composite = 2.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 71 Hz @ +6 dB/oct  
71 - 250 Hz @ 0.2 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0031 g<sup>2</sup>/Hz

Composite = 9.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0022 g<sup>2</sup>/Hz  
20 - 84 Hz @ +6 dB/oct  
84 - 410 Hz @ 0.038 g<sup>2</sup>/Hz  
410 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0019 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
20 - 71 Hz @ +6 dB/oct  
71 - 250 Hz @ 0.2 g<sup>2</sup>/Hz  
250 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0031 g<sup>2</sup>/Hz

Composite = 9.0 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00044 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 160 Hz @ 0.055 g<sup>2</sup>/Hz  
160 - 200 Hz @ -9 dB/oct  
200 - 500 Hz @ 0.028 g<sup>2</sup>/Hz  
500 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0018 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>



3-5-2-B (Cont.)

1. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

Subzone 3-5-2-C Input to Components Mounted on the ET LO<sub>2</sub> Aft  
Bulkhead Cap (Station X<sub>t</sub> 854). Weight of Component  
≥ 150 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @ 0.004 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +6 dB/oct  
 50 - 250 Hz @ 0.025 g<sup>2</sup>/Hz  
 250 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0004 g<sup>2</sup>/Hz

Composite = 3.2 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00055 g<sup>2</sup>/Hz  
 20 - 84 Hz @ +6 dB/oct  
 84 - 410 Hz @ 0.0095 g<sup>2</sup>/Hz  
 410 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.00047 g<sup>2</sup>/Hz

Composite = 2.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +6 dB/oct  
 50 - 250 Hz @ 0.1 g<sup>2</sup>/Hz  
 250 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0016 g<sup>2</sup>/Hz

Composite = 6.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.0022 g<sup>2</sup>/Hz  
 20 - 84 Hz @ +6 dB/oct  
 84 - 410 Hz @ 0.038 g<sup>2</sup>/Hz  
 410 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0016 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @ 0.016 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +6 dB/oct  
 50 - 250 Hz @ 0.1 g<sup>2</sup>/Hz  
 250 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.001 g<sup>2</sup>/Hz

Composite = 6.3 g<sub>rms</sub>

Directions B and C

20 Hz @ 0.00044 g<sup>2</sup>/Hz  
 20 - 100 Hz @ -9 dB/oct  
 100 - 160 Hz @ 0.055 g<sup>2</sup>/Hz  
 160 - 200 Hz @ -9 dB/oct  
 200 - 500 Hz @ 0.028 g<sup>2</sup>/Hz  
 500 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0018 g<sup>2</sup>/Hz

Composite = 5.0 g<sub>rms</sub>

5-2-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

Direction A - Perpendicular to Bulkhead

Direction B - Tangential to Bulkhead

Direction C - Tangential to Bulkhead, Perpendicular to Direction B

\* Design Criteria Only

C-7

Subzone 4-1 ET LO<sub>2</sub> Cylinder (Stations X<sub>T</sub> 852 to X<sub>T</sub> 747) and not within ±10° of the GO<sub>2</sub> Pressure Line/Cable Tray Installation. (General Specifications)

Same as Subzone 4-1-A below

Subzone 4-1-A Input to Components Mounted on the ET LO Cylinder (Stations X<sub>T</sub> 852 to X<sub>T</sub> 747) and not within ±10° of the GO<sub>2</sub> Pressure Line/Cable Tray Installation. Weight of Components < 15 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.062 g<sup>2</sup>/Hz  
20 - 40 Hz @ +3 dB/oct  
40 - 400 Hz @ 0.012 g<sup>2</sup>/Hz  
400 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.22 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.056 g<sup>2</sup>/Hz

Composite = 16.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00030 g<sup>2</sup>/Hz  
20 - 100 Hz @ +9 dB/oct  
100 - 260 Hz @ 0.37 g<sup>2</sup>/Hz  
260 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.10 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 11.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 13.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0016 g<sup>2</sup>/Hz  
20 - 100 Hz @ +6 dB/oct  
100 - 550 Hz @ 0.040 g<sup>2</sup>/Hz  
550 - 700 Hz @ +9 dB/oct  
700 - 1000 Hz @ 0.080 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.040 g<sup>2</sup>/Hz

Composite = 10.4 g<sub>rms</sub>

#### 4-1-A (Cont.)

### 3. Boost Random Vibration Criteria (2 min/axis)

#### Radial Axis

20 Hz @  $0.25 \text{ g}^2/\text{Hz}$   
20 - 40 Hz @ +3 dB/oct  
40 - 400 Hz @  $0.50 \text{ g}^2/\text{Hz}$   
400 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @  $0.90 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.23 \text{ g}^2/\text{Hz}$

Composite =  $33.4 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 Hz @  $0.0012 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +9 dB/oct  
100 - 260 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
260 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @  $0.42 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.21 \text{ g}^2/\text{Hz}$

Composite =  $23.8 \text{ g}_{\text{rms}}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

**Subzone 4-1-B** Input to Components Mounted on the ET LO<sub>2</sub> Cylinder  
 (Stations X<sub>T</sub> 852 to X<sub>T</sub> 747) and not within  $\pm 10^\circ$  of the  
 GO<sub>2</sub> Pressure Line/Cable Tray Installation. Weight of  
 Components  $\geq 15$  but  $< 45$  lb.

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.032 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 400 Hz @ 0.062 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +3 dB/oct  
 700 - 1000 Hz @ 0.11 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 11.8 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.00030 g<sup>2</sup>/Hz  
 20 - 80 Hz @ +9 dB/oct  
 80 - 260 Hz @ 0.019 g<sup>2</sup>/Hz  
 260 - 700 Hz @ +3 dB/oct  
 700 - 1000 Hz @ 0.050 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.037 g<sup>2</sup>/Hz

Composite = 8.4 g<sub>rms</sub>

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 9.4 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0016 g<sup>2</sup>/Hz  
 20 - 70 Hz @ +6 dB/oct  
 70 - 550 Hz @ 0.020 g<sup>2</sup>/Hz  
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @ 0.040 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.020 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @ 0.13 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 400 Hz @ 0.25 g<sup>2</sup>/Hz  
 400 - 700 Hz @ +3 dB/oct  
 700 - 1000 Hz @ 0.45 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.12 g<sup>2</sup>/Hz

Composite = 23.6 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0012 g<sup>2</sup>/Hz  
 20 - 80 Hz @ +9 dB/oct  
 80 - 260 Hz @ 0.075 g<sup>2</sup>/Hz  
 260 - 700 Hz @ +3 dB/oct  
 700 - 1000 Hz @ 0.21 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.11 g<sup>2</sup>/Hz

Composite = 16.9 g<sub>rms</sub>

**4-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 4-1-C Input to Components Mounted on the ET LO<sub>2</sub> Cylinder  
(Stations X<sub>T</sub> 852 and X<sub>T</sub> 747) and not within  $\pm 10^\circ$  of  
the GO<sub>2</sub> Pressure Line/Cable Tray Installation. Weight  
of Components  $\geq 45$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 20 Hz @ 0.015 g<sup>2</sup>/Hz  
40 - 40 Hz @ +3 dB/oct  
40 - 400 Hz @ 0.030 g<sup>2</sup>/Hz  
400 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.055 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.014 g<sup>2</sup>/Hz

Composite = 8.2 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.00030 g<sup>2</sup>/Hz  
62 - 62 Hz @ +9 dB/oct  
62 - 260 Hz @ 0.0095 g<sup>2</sup>/Hz  
260 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.025 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.012 g<sup>2</sup>/Hz

Composite = 5.9 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @ 0.030 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0075 g<sup>2</sup>/Hz

Composite = 6.7 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.0016 g<sup>2</sup>/Hz  
50 - 50 Hz @ +6 dB/oct  
50 - 550 Hz @ 0.010 g<sup>2</sup>/Hz  
550 - 700 Hz @ +9 dB/oct  
700 - 1000 Hz @ 0.020 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.010 g<sup>2</sup>/Hz

Composite = 5.2 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 20 Hz @ 0.060 g<sup>2</sup>/Hz  
40 - 40 Hz @ +3 dB/oct  
40 - 400 Hz @ 0.12 g<sup>2</sup>/Hz  
400 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.22 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.055 g<sup>2</sup>/Hz

Composite = 16.4 g<sub>rms</sub>

Long. and Tang. Axes

20 - 20 Hz @ 0.0012 g<sup>2</sup>/Hz  
62 - 62 Hz @ +9 dB/oct  
62 - 260 Hz @ 0.038 g<sup>2</sup>/Hz  
260 - 700 Hz @ +3 dB/oct  
700 - 1000 Hz @ 0.10 g<sup>2</sup>/Hz  
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @ 0.050 g<sup>2</sup>/Hz

Composite = 11.8 g<sub>rms</sub>



4-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 4-1-AP Input to Components Mounted on the LO<sub>2</sub> Cylinder (X<sub>T</sub> 852 to X<sub>T</sub> 747) and within ±10° of the GO<sub>2</sub> Press. Line/ Cable Tray Installation. Weight of Components < 15 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 76 Hz @ 0.05 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 16.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00010 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +10 dB/oct  
 150 - 1000 Hz @ 0.08 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.02 g<sup>2</sup>/Hz

Composite = 10.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 13.3 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0016 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +6 dB/oct  
 100 - 550 Hz @ 0.040 g<sup>2</sup>/Hz  
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @ 0.080 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.040 g<sup>2</sup>/Hz

Composite = 10.4 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.1 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 76 Hz @ 0.2 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.8 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.1 g<sup>2</sup>/Hz

Composite = 32.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00041 g<sup>2</sup>/Hz  
 20 - 150 Hz @ +10 dB/oct  
 150 - 1000 Hz @ 0.32 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.08 g<sup>2</sup>/Hz

Composite = 21.0 g<sub>rms</sub>

4-1-AP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 4-1-BP Input to Components Mounted on the LO<sub>2</sub> Cylinder (X<sub>T</sub> 852 to X<sub>T</sub> 747) and within ±10° of the GO<sub>2</sub> Press. Line/Cable Tray Installation. Weight of Component ≥ 15 but < 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @ 0.018 g<sup>2</sup>/Hz  
 20 - 29 Hz @ +3 dB/oct  
 29 - 76 Hz @ 0.025 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.1 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.013 g<sup>2</sup>/Hz

Composite = 11.2 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00010 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +10 dB/oct  
 120 - 1000 Hz @ 0.04 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.01 g<sup>2</sup>/Hz

Composite = 7.5 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @ 0.060 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.015 g<sup>2</sup>/Hz

Composite = 9.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0016 g<sup>2</sup>/Hz  
 20 - 70 Hz @ +6 dB/oct  
 70 - 550 Hz @ 0.020 g<sup>2</sup>/Hz  
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @ 0.040 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.020 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @ 0.07 g<sup>2</sup>/Hz  
 20 - 29 Hz @ +3 dB/oct  
 29 - 76 Hz @ 0.1 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.4 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 22.4 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00041 g<sup>2</sup>/Hz  
 20 - 120 Hz @ +10 dB/oct  
 120 - 1000 Hz @ 0.16 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.04 g<sup>2</sup>/Hz

Composite = 15.0 g<sub>rms</sub>

4-1-BP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 4-1-CP Input to Components Mounted on the LO<sub>2</sub> Cylinder (X<sub>T</sub> 852 to X<sub>T</sub> 747) and within ±10° of the GO<sub>2</sub> Press. Line/ Cable Tray Installation. Weight of Component ≥ 45 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 76 Hz @ 0.013 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.05 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.0063 g<sup>2</sup>/Hz

Composite = 8.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00010 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +10 dB/oct  
 100 - 1000 Hz @ 0.02 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.005 g<sup>2</sup>/Hz

Composite = 5.4 g<sub>rms</sub>

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @ 0.030 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.0075 g<sup>2</sup>/Hz

Composite = 6.7 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.0016 g<sup>2</sup>/Hz  
 20 - 50 Hz @ +6 dB/oct  
 50 - 550 Hz @ 0.010 g<sup>2</sup>/Hz  
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @ 0.020 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.010 g<sup>2</sup>/Hz

Composite = 5.2 g<sub>rms</sub>

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 76 Hz @ 0.05 g<sup>2</sup>/Hz  
 76 - 150 Hz @ +6 dB/oct  
 150 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -9 dB/oct  
 2000 Hz @ 0.025 g<sup>2</sup>/Hz

Composite = 16.0 g<sub>rms</sub>

Long. and Tang. Axes

20 Hz @ 0.00041 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +10 dB/oct  
 100 - 1000 Hz @ 0.08 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.02 g<sup>2</sup>/Hz

Composite = 10.7 g<sub>rms</sub>

4-1-CA (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 5-1 ET Ogive, Aft Section (Stations  $X_T$  747 to  $X_T$  537)  
and not within  $\pm 10^\circ$  of the  $GO_2$  Pressure Line/Cable  
Tray Installation (General Specifications)

Same as 5-1-A below

Subzone 5-1-A Input to Components Mounted on the ET Ogive, Aft  
Section (Stations  $X_T$  747 to  $X_T$  537) and not within  $\pm 10^\circ$   
of the  $GO_2$  Pressure Line/Cable Tray Installation. Weight  
of Component < 10 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0075 \text{ g}^2/\text{Hz}$

Composite =  $6.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00045 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 550 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
550 - 700 Hz @ +9 dB/oct  
700 - 1000 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.011 \text{ g}^2/\text{Hz}$

Composite =  $5.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $13.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0018 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +6 dB/oct  
100 - 550 Hz @  $0.046 \text{ g}^2/\text{Hz}$   
550 - 700 Hz @ +9 dB/oct  
700 - 1000 Hz @  $0.092 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.046 \text{ g}^2/\text{Hz}$

Composite =  $11.1 \text{ g}_{\text{rms}}$



### 5-1-A (Cont.)

#### 3. Boost Random Vibration Criteria (2 min/axis)

##### Radial Axis

20 - 150 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
150 - 600 Hz @ +3 dB/oct  
600 - 1000 Hz @  $0.12 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $12.1 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.000040 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +10 dB/oct  
100 - 160 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
160 - 630 Hz @ +4 dB/oct  
630 - 1000 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $9.0 \text{ g}_{\text{rms}}$

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only



Subzone 5-1-B Input to Components Mounted on the ET Ogive, Aft Section (Stations  $X_T$  747 to  $X_T$  537) and not within  $\pm 10^\circ$  of the  $GO_2$  Pressure Line/Cable Tray Installation. Weight of Component  $> 10$  but  $< 30$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0037 \text{ g}^2/\text{Hz}$

Composite =  $4.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00045 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +6 dB/oct  
 70 - 550 Hz @  $0.0056 \text{ g}^2/\text{Hz}$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0056 \text{ g}^2/\text{Hz}$

Composite =  $4.0 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $9.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0018 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +6 dB/oct  
 70 - 550 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.046 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $7.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 150 Hz @  $0.015 \text{ g}^2/\text{Hz}$   
 150 - 600 Hz @ +3 dB/oct  
 600 - 1000 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $8.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00040 \text{ g}^2/\text{Hz}$   
 20 - 82 Hz @ +10 dB/oct  
 82 - 160 Hz @  $0.0050 \text{ g}^2/\text{Hz}$   
 160 - 630 Hz @ +4 dB/oct  
 630 - 1000 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $6.4 \text{ g}_{\text{rms}}$

**5-1-B (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

See Table I

\* Design Criteria Only

Subzone 5-1-C Input to Components Mounted on the ET Ogive, Aft Section (Stations  $X_T$  747 to  $X_T$  537) and not within  $\pm 10^\circ$  of the  $GO_2$  Pressure Line/Cable Tray Installation. Weight of Component  $> 30$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.0075 g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0018 g^2/Hz$

Composite =  $3.3 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.0045 g^2/Hz$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 550 Hz @  $0.0027 g^2/Hz$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.0056 g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0027 g^2/Hz$

Composite =  $2.7 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.030 g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0075 g^2/Hz$

Composite =  $6.7 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.0018 g^2/Hz$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 550 Hz @  $0.011 g^2/Hz$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.023 g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.011 g^2/Hz$

Composite =  $5.5 g_{rms}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 150 Hz @  $0.0075 g^2/Hz$   
 150 - 600 Hz @ +3 dB/oct  
 600 - 1000 Hz @  $0.0031 g^2/Hz$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0075 g^2/Hz$

Composite =  $6.0 g_{rms}$

Long. and Tang. Axes

20 Hz @  $0.000040 g^2/Hz$   
 20 - 68 Hz @ +10 dB/oct  
 68 - 160 Hz @  $0.0031 g^2/Hz$   
 160 - 630 Hz @ +4 dB/oct  
 630 - 1000 Hz @  $0.019 g^2/Hz$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0085 g^2/Hz$

Composite =  $5.0 g_{rms}$

**5-1-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

**2 - 5 Hz @ 0.6 G's peak\***

**5 - 40 Hz @ 0.6 G's peak**

**Lateral Axes**

**2 - 5 Hz @ 0.8 G's peak\***

**5 - 40 Hz @ 0.8 G's peak**

**5. Shock Test Criteria (2 shocks/axis)**

**See Table I**

**\* Design Criteria Only**

**Subzone 5-1-AP Input to Components Mounted on the Ogive Aft Section**  
**(X<sub>T</sub> 747 to X<sub>T</sub> 537) and within  $\pm 10^\circ$  of the GO<sub>2</sub> Press.**  
**Line/Cable Tray Installation. Weight of Component**  
**< 10 lb.**

**1. Acceptance Test Criteria (1 min/axis)**

**Radial Axis**

20 Hz @ 0.025 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 100 Hz @ 0.05 g<sup>2</sup>/Hz  
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @ 0.2 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 16.7 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.00010 g<sup>2</sup>/Hz  
 20 - 160 Hz @ +10 dB/oct  
 160 - 1000 Hz @ 0.1 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.05 g<sup>2</sup>/Hz

Composite = 12.5 g<sub>rms</sub>

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Radial Axis**

20 - 1000 Hz @ 0.12 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.030 g<sup>2</sup>/Hz

Composite = 13.3 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.0018 g<sup>2</sup>/Hz  
 20 - 100 Hz @ +6 dB/oct  
 100 - 550 Hz @ 0.046 g<sup>2</sup>/Hz  
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @ 0.092 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.046 g<sup>2</sup>/Hz

Composite = 11.1 g<sub>rms</sub>

**3. Boost Random Vibration Criteria (2 min/axis)**

**Radial Axis**

20 Hz @ 0.1 g<sup>2</sup>/Hz  
 20 - 40 Hz @ +3 dB/oct  
 40 - 100 Hz @ 0.2 g<sup>2</sup>/Hz  
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @ 0.8 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 33.3 g<sub>rms</sub>

**Long. and Tang. Axes**

20 Hz @ 0.00042 g<sup>2</sup>/Hz  
 20 - 160 Hz @ +10 dB/oct  
 160 - 1000 Hz @ 0.4 g<sup>2</sup>/Hz  
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @ 0.2 g<sup>2</sup>/Hz

Composite = 25.0 g<sub>rms</sub>

#### 4. Vehicle Dynamics Criteria

##### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

##### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

#### 5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 5-1-BP Input to Components Mounted on the Ogive Aft Section  
 ( $X_T$  747 to  $X_T$  537) and within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/Cable Tray Installation. Weight of Component  $\geq 10$   
 but  $< 30$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
 20 - 29 Hz @ +3 dB/oct  
 29 - 100 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $12.5 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00010 \text{ g}^2/\text{Hz}$   
 20 - 130 Hz @ +10 dB/oct  
 130 - 1000 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $8.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.060 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.015 \text{ g}^2/\text{Hz}$

Composite =  $9.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0018 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +6 dB/oct  
 70 - 550 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.046 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.023 \text{ g}^2/\text{Hz}$

Composite =  $7.9 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
 20 - 29 Hz @ +3 dB/oct  
 29 - 100 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @  $0.4 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.1 \text{ g}^2/\text{Hz}$

Composite =  $24.9 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00042 \text{ g}^2/\text{Hz}$   
 20 - 130 Hz @ +10 dB/oct  
 130 - 1000 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.1 \text{ g}^2/\text{Hz}$

Composite =  $17.8 \text{ g}_{\text{rms}}$



5-1-BP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 5-1-CP Input to Components Mounted on the Ogive Aft Section  
 ( $X_T$  747 to  $X_T$  537) and within  $\pm 10^\circ$  of the  $GO_2$  Press.  
 Line/Cable Tray Installation. Weight of Component  
 $\geq 30$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 - 100 Hz @  $0.013 \text{ g}^2/\text{Hz}$   
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $8.6 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00010 \text{ g}^2/\text{Hz}$   
 20 - 105 Hz @ +10 dB/oct  
 105 - 1000 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.013 \text{ g}^2/\text{Hz}$

Composite =  $6.4 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Radial Axis

20 - 1000 Hz @  $0.030 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.0075 \text{ g}^2/\text{Hz}$

Composite =  $6.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.0018 \text{ g}^2/\text{Hz}$   
 20 - 50 Hz @ +6 dB/oct  
 50 - 550 Hz @  $0.011 \text{ g}^2/\text{Hz}$   
 550 - 700 Hz @ +9 dB/oct  
 700 - 1000 Hz @  $0.023 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.011 \text{ g}^2/\text{Hz}$

Composite =  $5.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 - 100 Hz @  $0.05 \text{ g}^2/\text{Hz}$   
 100 - 200 Hz @ +6 dB/oct  
 200 - 1000 Hz @  $0.2 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $17.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00042 \text{ g}^2/\text{Hz}$   
 20 - 105 Hz @ +10 dB/oct  
 105 - 1000 Hz @  $0.1 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.05 \text{ g}^2/\text{Hz}$

Composite =  $12.7 \text{ g}_{\text{rms}}$

5-1-CP (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

5. Shock Test Criteria (2 shocks/axis)

See Table I

\* Design Criteria Only

Subzone 5-2 ET Ogive, Forward Section (Stations  $X_t$  537 to  $X_t$  371).  
(General Specifications)

Same as Subzone 5-2-A below.

Subzone 5-2-A Input to Components Mounted on the ET Ogive, Forward Section (Stations  $X_t$  537 to  $X_t$  371) and not within  $\pm 10^\circ$  of the  $GO_2$  Pressure Line/Cable Tray Installation. Weight of Component  $\leq 7$  lbs.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @  $0.0065 g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 150 Hz @  $0.10 g^2/Hz$   
150 - 300 Hz @ +6 dB/oct  
300 - 500 Hz @  $0.40 g^2/Hz$   
500 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.10 g^2/Hz$

Composite =  $20.0 g_{rms}$

Directions B and C

20 Hz @  $0.000075 g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 500 Hz @  $0.010 g^2/Hz$   
500 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $0.020 g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.010 g^2/Hz$

Composite =  $5.2 g_{rms}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.026 g^2/Hz$   
20 - 80 Hz @ +6 dB/oct  
80 - 150 Hz @  $0.40 g^2/Hz$   
150 - 300 Hz @ +6 dB/oct  
300 - 500 Hz @  $1.60 g^2/Hz$   
500 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.41 g^2/Hz$

Composite =  $40.1 g_{rms}$

Directions B and C

20 Hz @  $0.00030 g^2/Hz$   
20 - 100 Hz @ +9 dB/oct  
100 - 500 Hz @  $0.040 g^2/Hz$   
500 - 700 Hz @ +6 dB/oct  
700 - 1000 Hz @  $0.080 g^2/Hz$   
1000 - 2000 Hz @ -3 dB/oct  
2000 Hz @  $0.040 g^2/Hz$

Composite =  $10.4 g_{rms}$

5-2-A (Cont.)

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.0015 \text{ g}^2/\text{Hz}$   
20 - 400 Hz @ +6 dB/oct  
400 - 800 Hz @  $0.60 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.097 \text{ g}^2/\text{Hz}$

Composite =  $24.7 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00032 \text{ g}^2/\text{Hz}$   
20 - 600 Hz @ +4 dB/oct  
600 - 2000 Hz @  $0.030 \text{ g}^2/\text{Hz}$

Composite =  $7.1 \text{ g}_{\text{rms}}$

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable.

Direction A - Perpendicular to Ogive

Direction B - Tangential to Ogive

Direction C - Tangential to Ogive, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-2-B Input to Components Mounted on the ET Ogive, Forward Section (Stations  $X_t$  537 to  $X_t$  371) and not within  $\pm 10^\circ$  of the  $CO_2$  Pressure Line/Cable Tray Installation. Weight of Component  $\geq 7$  but  $< 21$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 56 Hz @ +6 dB/oct  
 56 - 150 Hz @  $0.050 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.050 \text{ g}^2/\text{Hz}$

Composite =  $14.2 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +9 dB/oct  
 80 - 500 Hz @  $0.0050 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$

Composite =  $3.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 56 Hz @ +6 dB/oct  
 56 - 150 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.20 \text{ g}^2/\text{Hz}$

Composite =  $28.4 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +9 dB/oct  
 80 - 500 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $7.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.0015 \text{ g}^2/\text{Hz}$   
 20 - 280 Hz @ +6 dB/oct  
 280 - 800 Hz @  $0.30 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.048 \text{ g}^2/\text{Hz}$

Composite =  $18.1 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00016 \text{ g}^2/\text{Hz}$   
 20 - 600 Hz @ +4 dB/oct  
 600 - 2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$

**5-2-E (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

Not Applicable

Direction A - Perpendicular to Ogive

Direction B - Tangential to Ogive

Direction C - Tangential to Ogive, Perpendicular to Direction B

\* Design Criteria Only

**Subzone 5-2-C** Input to Components Mounted on the ET Ogive, Forward Section (Stations  $X_t$  537 to  $X_t$  371) and not within  $\pm 10^\circ$  of the  $GO_2$  Pressure Line/Cable Tray Installation. Weight of Component  $\geq 21$  lb.

**1. Acceptance Test Criteria (1 min/axis)**

**Direction A**

20 Hz @  $0.0065 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 150 Hz @  $0.025 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.025 \text{ g}^2/\text{Hz}$

Composite =  $10.0 \text{ g}_{\text{rms}}$

**Directions B and C**

20 Hz @  $0.000075 \text{ g}^2/\text{Hz}$   
 20 - 64 Hz @ +9 dB/oct  
 64 - 500 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.0050 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.0025 \text{ g}^2/\text{Hz}$

Composite =  $2.6 \text{ g}_{\text{rms}}$

**2. Lift-off Random Vibration Criteria (1 min/axis)**

**Direction A**

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 150 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $20.1 \text{ g}_{\text{rms}}$

**Directions B and C**

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 64 Hz @ +9 dB/oct  
 64 - 500 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $5.2 \text{ g}_{\text{rms}}$

**3. Boost Random Vibration Criteria (2 min/axis)**

**Direction A**

20 Hz @  $0.0015 \text{ g}^2/\text{Hz}$   
 20 - 200 Hz @ +6 dB/oct  
 200 - 800 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 800 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.024 \text{ g}^2/\text{Hz}$

Composite =  $13.1 \text{ g}_{\text{rms}}$

**Directions B and C**

20 Hz @  $0.00016 \text{ g}^2/\text{Hz}$   
 20 - 600 Hz @ +4 dB/oct  
 600 - 2000 Hz @  $0.014 \text{ g}^2/\text{Hz}$

Composite =  $5.0 \text{ g}_{\text{rms}}$



**5-2-C (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.5 G's peak

**Lateral Axes**

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

**Not Applicable**

**Direction A — Perpendicular to Ogive**

**Direction B — Tangential to Ogive**

**Direction C — Tangential to Ogive, Perpendicular to Direction B**

**\* Design Criteria Only**

Subzone 5-2-AP Input to Components Mounted on the Ogive Forward Section ( $X_T$  537 to  $X_T$  371) and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component < 7 lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @  $0.00013 \text{ g}^2/\text{Hz}$   
 20 - 270 Hz @ +12 dB/oct  
 270 - 900 Hz @  $3.5 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.73 \text{ g}^2/\text{Hz}$

Composite =  $64.0 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00088 \text{ g}^2/\text{Hz}$   
 20 - 190 Hz @ +10 dB/oct  
 190 - 1000 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $15.2 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +6 dB/oct  
 80 - 150 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $1.60 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.41 \text{ g}^2/\text{Hz}$

Composite =  $46.1 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +9 dB/oct  
 100 - 500 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.080 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $10.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.0005 \text{ g}^2/\text{Hz}$   
 20 - 270 Hz @ +12 dB/oct  
 270 - 900 Hz @  $14.0 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $2.9 \text{ g}^2/\text{Hz}$

Composite =  $128.0 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00035 \text{ g}^2/\text{Hz}$   
 20 - 190 Hz @ +10 dB/oct  
 190 - 1000 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.3 \text{ g}^2/\text{Hz}$

Composite =  $30.4 \text{ g}_{\text{rms}}$

**5-2-AP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

Not Applicable.

Direction A - Perpendicular to Ogive

Direction B - Tangential to Ogive

Direction C - Tangential to Ogive, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-2-BP Input to Components Mounted on the Ogive Forward Section ( $X_T$  537 to  $X_T$  371) and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component  $\geq 7$  but  $< 21$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @  $0.00013 \text{ g}^2/\text{Hz}$   
 20 - 230 Hz @ +12 dB/oct  
 230 - 900 Hz @  $1.75 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.38 \text{ g}^2/\text{Hz}$

Composite =  $45.7 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.000088 \text{ g}^2/\text{Hz}$   
 20 - 155 Hz @ +10 dB/oct  
 155 - 1000 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.038 \text{ g}^2/\text{Hz}$

Composite =  $10.9 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 56 Hz @ +6 dB/oct  
 56 - 150 Hz @  $0.20 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.80 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.20 \text{ g}^2/\text{Hz}$

Composite =  $28.4 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +9 dB/oct  
 80 - 500 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $7.4 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.0005 \text{ g}^2/\text{Hz}$   
 20 - 230 Hz @ +12 dB/oct  
 230 - 900 Hz @  $7.0 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $1.5 \text{ g}^2/\text{Hz}$

Composite =  $91.3 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00035 \text{ g}^2/\text{Hz}$   
 20 - 155 Hz @ +10 dB/oct  
 155 - 1000 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.15 \text{ g}^2/\text{Hz}$

Composite =  $21.7 \text{ g}_{\text{rms}}$

**5-2-BP (Cont.)**

**4. Vehicle Dynamics Criteria**

**Longitudinal Axis**

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

**Lateral Axes**

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

**5. Shock Test Criteria (2 shocks/axis)**

Not Applicable

Direction A — Perpendicular to Ogive

Direction B — Tangential to Ogive

Direction C — Tangential to Ogive, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-2-CP Input to Components Mounted on the Ogive Forward Section ( $X_T$  537 to  $X_T$  371) and within  $\pm 10^\circ$  of the  $GO_2$  Press. Line/Cable Tray Installation. Weight of Component  $\geq 21$  lb.

1. Acceptance Test Criteria (1 min/axis)

Direction A

20 Hz @  $0.00013 \text{ g}^2/\text{Hz}$   
 20 - 190 Hz @ +7 dB/oct  
 190 - 900 Hz @  $0.88 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.19 \text{ g}^2/\text{Hz}$

Composite =  $34.5 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.000088 \text{ g}^2/\text{Hz}$   
 20 - 125 Hz @ +10 dB/oct  
 125 - 1000 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.019 \text{ g}^2/\text{Hz}$

Composite =  $7.8 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.026 \text{ g}^2/\text{Hz}$   
 20 - 40 Hz @ +6 dB/oct  
 40 - 150 Hz @  $0.10 \text{ g}^2/\text{Hz}$   
 150 - 300 Hz @ +6 dB/oct  
 300 - 500 Hz @  $0.40 \text{ g}^2/\text{Hz}$   
 500 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.10 \text{ g}^2/\text{Hz}$

Composite =  $20.1 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00030 \text{ g}^2/\text{Hz}$   
 20 - 64 Hz @ +9 dB/oct  
 64 - 500 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 500 - 700 Hz @ +6 dB/oct  
 700 - 1000 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.010 \text{ g}^2/\text{Hz}$

Composite =  $5.2 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Direction A

20 Hz @  $0.0005 \text{ g}^2/\text{Hz}$   
 20 - 190 Hz @ +12 dB/oct  
 190 - 900 Hz @  $3.5 \text{ g}^2/\text{Hz}$   
 900 - 2000 Hz @ -6 dB/oct  
 2000 Hz @  $0.75 \text{ g}^2/\text{Hz}$

Composite =  $69.0 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00035 \text{ g}^2/\text{Hz}$   
 20 - 125 Hz @ +10 dB/oct  
 125 - 1000 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 1000 - 2000 Hz @ -3 dB/oct  
 2000 Hz @  $0.075 \text{ g}^2/\text{Hz}$

Composite =  $15.5 \text{ g}_{\text{rms}}$

5-2-CP(Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A - Perpendicular to Ogive

Direction B - Tangential to Ogive

Direction C - Tangential to Ogive, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-3 ET Nose Cap and Cover Plate (Stations  $X_t$  371 to  $X_t$  322).  
(General Specifications)

Same as Subzone 5-3-1-A below.

Subzone 5-3-1 ET Nose Cap (Stations  $X_t$  371 to  $X_t$  322). (General Specifications)

Same as Subzone 5-3-1-A below.

Subzone 5-3-1-A Input to Components Mounted on the ET Nose Cap  
(Stations  $X_t$  371 to  $X_t$  322). Weight of Component < 7 lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0024 \text{ g}^2/\text{Hz}$   
20 - 900 Hz @ +6 dB/oct  
900 - 2000 Hz @  $5.0 \text{ g}^2/\text{Hz}$

Composite =  $83.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00024 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +10 dB/oct  
140 - 240 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
240 - 900 Hz @ +3 dB/oct  
900 - 2000 Hz @  $0.45 \text{ g}^2/\text{Hz}$

Composite =  $26.5 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +6 dB/oct  
140 - 520 Hz @  $0.35 \text{ g}^2/\text{Hz}$   
520 - 900 Hz @ +6 dB/oct  
900 - 2000 Hz @  $1.00 \text{ g}^2/\text{Hz}$

Composite =  $38.6 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00033 \text{ g}^2/\text{Hz}$   
20 - 100 Hz @ +9 dB/oct  
100 - 500 Hz @  $0.040 \text{ g}^2/\text{Hz}$   
500 - 800 Hz @ +6 dB/oct  
800 - 2000 Hz @  $0.080 \text{ g}^2/\text{Hz}$

Composite =  $11.5 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.0094 \text{ g}^2/\text{Hz}$   
20 - 900 Hz @ +6 dB/oct  
900 - 2000 Hz @  $20.0 \text{ g}^2/\text{Hz}$

Composite =  $167.3 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00094 \text{ g}^2/\text{Hz}$   
20 - 140 Hz @ +10 dB/oct  
140 - 240 Hz @  $0.6 \text{ g}^2/\text{Hz}$   
240 - 900 Hz @ +3 dB/oct  
900 - 2000 Hz @  $1.8 \text{ g}^2/\text{Hz}$

Composite =  $52.9 \text{ g}_{\text{rms}}$



5-3-1-A (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A — Perpendicular to Nose Cap

Direction B — Tangential to Nose Cap

Direction C — Tangential to Nose Cap, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-3-1-B Input to Components Mounted on the ET Nose Cap  
 (Stations  $X_t$  371 to  $X_t$  322). Weight of Component  $\geq 7$   
 but  $< 20$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0024 \text{ g}^2/\text{Hz}$   
 20 - 640 Hz @ +6 dB/oct  
 640 - 2000 Hz @  $2.5 \text{ g}^2/\text{Hz}$

Composite =  $62.7 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00024 \text{ g}^2/\text{Hz}$   
 20 - 125 Hz @ +10 dB/oct  
 125 - 240 Hz @  $0.075 \text{ g}^2/\text{Hz}$   
 240 - 900 Hz @ +3 dB/oct  
 900 - 2000 Hz @  $0.23 \text{ g}^2/\text{Hz}$

Composite =  $18.7 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 100 Hz @ +6 dB/oct  
 100 - 520 Hz @  $0.18 \text{ g}^2/\text{Hz}$   
 520 - 900 Hz @ +6 dB/oct  
 900 - 2000 Hz @  $0.50 \text{ g}^2/\text{Hz}$

Composite =  $27.4 \text{ g}_{\text{rms}}$

Directions B and C

20 Hz @  $0.00033 \text{ g}^2/\text{Hz}$   
 20 - 80 Hz @ +9 dB/oct  
 80 - 500 Hz @  $0.020 \text{ g}^2/\text{Hz}$   
 500 - 800 Hz @ +6 dB/oct  
 800 - 2000 Hz @  $0.040 \text{ g}^2/\text{Hz}$

Composite =  $8.0 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.0094 \text{ g}^2/\text{Hz}$   
 20 - 640 Hz @ +6 dB/oct  
 640 - 2000 Hz @  $10.0 \text{ g}^2/\text{Hz}$

Composite =  $125.4 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00094 \text{ g}^2/\text{Hz}$   
 20 - 125 Hz @ +10 dB/oct  
 125 - 240 Hz @  $0.3 \text{ g}^2/\text{Hz}$   
 240 - 900 Hz @ +3 dB/oct  
 900 - 2000 Hz @  $0.9 \text{ g}^2/\text{Hz}$

Composite =  $37.4 \text{ g}_{\text{rms}}$

5-3-1-B (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A - Perpendicular to Nose Cap

Direction B - Tangential to Nose Cap

Direction C - Tangential to Nose Cap, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-3-1-C Input to Components Mounted on the ET Nose Cap  
 (Stations  $X_t$  371 to  $X_t$  322). Weight of Component  
 $\geq 20$  lb.

1. Acceptance Test Criteria (1 min/axis)

Radial Axis

20 Hz @  $0.0024 \text{ g}^2/\text{Hz}$   
 20 - 450 Hz @ +6 dB/oct  
 450 - 2000 Hz @  $1.3 \text{ g}^2/\text{Hz}$

Composite =  $46.1 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00024 \text{ g}^2/\text{Hz}$   
 20 - 94 Hz @ +10 dB/oct  
 94 - 240 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
 240 - 900 Hz @ +3 dB/oct  
 900 - 2000 Hz @  $0.11 \text{ g}^2/\text{Hz}$

Composite =  $13.3 \text{ g}_{\text{rms}}$

2. Lift-off Random Vibration Criteria (1 min/axis)

Direction A

20 Hz @  $0.0075 \text{ g}^2/\text{Hz}$   
 20 - 70 Hz @ +6 dB/oct  
 70 - 520 Hz @  $0.090 \text{ g}^2/\text{Hz}$   
 520 - 900 Hz @ +6 dB/oct  
 900 - 2000 Hz @  $0.25 \text{ g}^2/\text{Hz}$

Composite =  $19.4 \text{ g}_{\text{rms}}$

Directions B & C

20 Hz @  $0.00033 \text{ g}^2/\text{Hz}$   
 20 - 63 Hz @ +9 dB/oct  
 63 - 500 Hz @  $0.010 \text{ g}^2/\text{Hz}$   
 500 - 800 Hz @ +6 dB/oct  
 800 - 2000 Hz @  $0.020 \text{ g}^2/\text{Hz}$

Composite =  $5.7 \text{ g}_{\text{rms}}$

3. Boost Random Vibration Criteria (2 min/axis)

Radial Axis

20 Hz @  $0.0094 \text{ g}^2/\text{Hz}$   
 20 - 450 Hz @ +6 dB/oct  
 450 - 2000 Hz @  $5.0 \text{ g}^2/\text{Hz}$

Composite =  $92.2 \text{ g}_{\text{rms}}$

Long. and Tang. Axes

20 Hz @  $0.00094 \text{ g}^2/\text{Hz}$   
 20 - 94 Hz @ +10 dB/oct  
 94 - 240 Hz @  $0.15 \text{ g}^2/\text{Hz}$   
 240 - 900 Hz @ +3 dB/oct  
 900 - 2000 Hz @  $0.45 \text{ g}^2/\text{Hz}$

Composite =  $26.5 \text{ g}_{\text{rms}}$

5-3-1-C (Cont.)

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
5 - 40 Hz @ 1.4 G's peak

5. Shock Test Criteria (2 shocks/axis)

Not Applicable

Direction A - Perpendicular to Nose Cap

Direction B - Tangential to Nose Cap

Direction C - Tangential to Nose Cap, Perpendicular to Direction B

\* Design Criteria Only

Subzone 5-3-2 Input to Components Mounted on the ET LO<sub>2</sub> Ogive  
Coverplate or Coverplate Support Ring. Station X<sub>t</sub>  
371)

1. Acceptance Test Criteria (1 min/axis)

Longitudinal Axis

20 Hz @ 0.0035 g<sup>2</sup>/Hz  
20 - 42 Hz @ +6 dB/oct  
42 - 370 Hz @ 0.015 g<sup>2</sup>/Hz  
370 - 900 Hz @ +6 dB/oct  
900 - 2000 Hz @ 0.088 g<sup>2</sup>/Hz

Composite = 11.2 g<sub>rms</sub>

Lateral Axes

20 Hz @ 0.00050 g<sup>2</sup>/Hz  
20 - 49 Hz @ +9 dB/oct  
49 - 2000 Hz @ 0.0075 g<sup>2</sup>/Hz

Composite = 3.8 g<sub>rms</sub>

2 and 3. Flight Random Vibration Criteria, Lift-off and Boost  
(3 minutes/axis)

Longitudinal Axis

20 Hz @ 0.0067 g<sup>2</sup>/Hz  
20 - 70 Hz @ +12 dB/oct  
70 - 100 Hz @ 1.0 g<sup>2</sup>/Hz  
100 - 320 Hz @ -6 dB/oct  
320 - 500 Hz @ 0.1 g<sup>2</sup>/Hz  
500 - 1000 Hz @ +6 dB/oct  
1000 - 1400 Hz @ 0.4 g<sup>2</sup>/Hz  
1400 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.096 g<sup>2</sup>/Hz

Composite 23.0 g<sub>rms</sub>

Radial & Tangential Axes

20 Hz @ 0.0024 g<sup>2</sup>/Hz  
20 - 60 Hz @ +12 dB/oct  
60 - 200 Hz @ 0.2 g<sup>2</sup>/Hz  
200 - 430 Hz @ -12 dB/oct  
430 - 1300 Hz @ 0.01 g<sup>2</sup>/Hz  
1300 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0018 g<sup>2</sup>/Hz

Composite = 7.4 g<sub>rms</sub>

4. Vehicle Dynamics Criteria

Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

Lateral Axes

2 - 6 Hz @ 1.4 G's peak\*  
6 - 40 Hz @ 1.4 G's peak

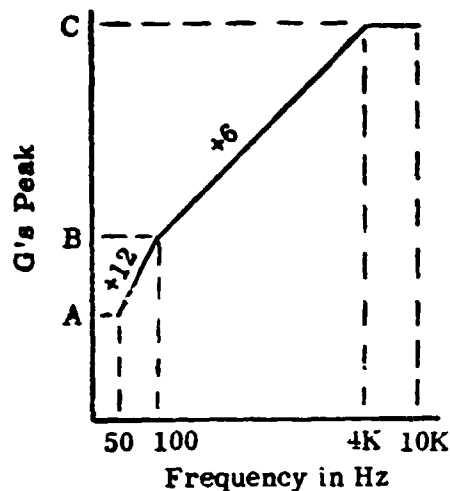
5. Shock Test Criteria (2 shocks/axis)

Not Applicable

\* Design Criteria Only

### SECTION III. SHOCK SPECIFICATIONS

#### PYROTECHNIC SHOCK SPECTRUM CRITERIA FOR COMPONENTS MOUNTED TO SPACE SHUTTLE STRUCTURE



#### SHOCK SPECTRUM

50 Hz @ A G's peak  
50 - 100 Hz @ +12 dB/oct  
100 Hz @ B G's peak  
100 - 4000 Hz @ +6 dB/oct  
4000 - 10000 Hz @ C G's peak

Note: For proper spectrum, use most severe of applicable levels from tables below.

TABLE I. LIGHTWEIGHT TANK

Shock Source	D = Distance from component to ET/SRB Fwd Attach Point (in.)	Spectrum Amplitudes		
		A	B	C
Fwd Attach Bolts	0 < D < 12	94	375	15,000
	12 < D < 24	47	188	7,500
	24 < D < 48	24	94	3,750
	48 < D < 96	12	47	1,875
	96 < D	N/A	N/A	N/A
	d = Distance from component to ET/SRB Aft Attach Point (in.)			
Aft Attach Bolts	0 < d < 12	24	94	3,750
	12 < d < 24	12	47	1,875
	24 < d	N/A	N/A	N/A

## SECTION IV. ACOUSTIC TEST SPECIFICATIONS

### Zone 1-1. ET Aft LH<sub>2</sub> Bulkhead Gores (General Specifications)

#### EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	127.0	143.5	159.0
6.3	129.5	144.5	158.0
8.0	131.5	145.5	157.0
10.0	134.0	146.5	156.0
12.5	136.0	147.5	155.0
16.0	138.0	148.5	154.0
20.0	140.0	149.5	153.0
25.0	142.0	150.5	152.0
31.5	144.0	151.0	151.0
40.0	145.5	152.0	150.0
50.0	147.5	152.5	148.0
63.0	149.0	153.0	146.0
80.0	150.0	153.0	144.0
100.0	151.0	153.0	142.0
125.0	152.0	153.0	140.0
160.0	153.0	153.0	138.0
200.0	153.5	153.0	136.0
250.0	154.0	153.0	134.0
315.0	154.5	152.5	132.0
400.0	154.5	152.0	130.0
500.0	154.0	151.5	128.0
630.0	153.5	151.0	126.0
800.0	153.5	150.0	124.0
1000.0	153.0	149.5	122.0
1250.0	152.5	148.5	120.0
1600.0	151.5	148.0	118.0
2000.0	151.0	147.0	116.0
2500.0	150.0	146.0	114.0
3150.0	149.0	145.0	112.0
4000.0	147.5	144.0	110.0
5000.0	146.5	143.0	108.0
6300.0	145.0	142.0	106.0
8000.0	144.0	141.0	104.0
10000.0	143.0	140.0	102.0
Overall SPL	165.5	165.5	165.5
Duration	1 min	2 min	N/A



# SECTION VIII. ACOUSTIC TEST SPECIFICATIONS

## Zone 1-2-ET Aft LH<sub>2</sub> Bulkhead (General Specifications)

### EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	127.0	138.0	159.0
6.3	129.5	139.0	158.0
8.0	131.5	140.0	157.0
10.0	134.0	141.0	156.0
12.5	136.0	142.0	155.0
16.0	138.0	142.5	154.0
20.0	140.0	143.0	153.0
25.0	142.0	144.0	152.0
31.5	144.0	144.5	151.0
40.0	145.5	145.0	150.0
50.0	147.5	145.5	148.0
63.0	149.0	146.0	146.0
80.0	150.0	146.5	144.0
100.0	151.0	147.0	142.0
125.0	152.0	147.0	140.0
160.0	153.0	147.0	138.0
200.0	153.5	147.0	136.0
250.0	154.0	147.0	134.0
315.0	154.5	146.5	132.0
400.0	154.5	146.0	130.0
500.0	154.0	146.0	128.0
630.0	153.5	145.5	126.0
800.0	153.5	145.0	124.0
1000.0	153.0	144.0	122.0
1250.0	152.5	143.0	120.0
1600.0	151.5	142.5	118.0
2000.0	151.0	142.0	116.0
2500.0	150.0	141.5	114.0
3150.0	149.0	140.5	112.0
4000.0	147.5	139.5	110.0
5000.0	146.5	138.5	108.0
6300.0	145.0	137.5	106.0
8000.0	144.0	137.0	104.0
10000.0	143.0	136.0	102.0
Overall SPL	165.5	159.5	165.5
Duration	1 min	2 min	N/A

Subzone 2-1 - ET LH<sub>2</sub> Tank Cylinder, Inboard (Orbiter) Side, Aft  
Section (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock
5.0	131.0	139.0	159.0
6.3	132.5	140.0	158.0
8.0	134.0	141.0	157.0
10.0	135.5	141.5	156.0
12.5	136.5	142.0	155.0
16.0	138.0	142.5	154.0
20.0	139.0	142.5	153.0
25.0	140.0	143.0	152.0
31.5	141.5	144.0	151.0
40.0	142.0	145.0	150.0
50.0	143.0	146.0	148.0
63.0	144.0	146.5	146.0
80.0	144.5	147.0	144.0
100.0	145.0	147.5	142.0
125.0	145.5	148.0	140.0
160.0	145.5	148.5	138.0
200.0	146.0	148.5	136.0
250.0	146.0	148.0	134.0
315.0	146.0	148.0	132.0
400.0	145.5	147.5	130.0
500.0	145.5	146.5	128.0
630.0	145.0	146.0	126.0
800.0	144.5	145.5	124.0
1000.0	143.5	144.5	122.0
1250.0	143.0	144.0	120.0
1600.0	142.0	143.5	118.0
2000.0	141.0	143.0	116.0
2500.0	140.0	142.5	114.0
3150.0	139.5	141.5	112.0
4000.0	138.5	141.0	110.0
5000.0	137.5	140.0	108.0
6300.0	137.0	139.0	106.0
8000.0	136.0	138.5	104.0
10000.0	135.0	138.0	102.0
Overall SPL	158.0	160.0	165.5
Duration	1 min	2 min	N/A

Subzone 2-2 - ET LH<sub>2</sub> Tank Cylinder, Outboard Side, Aft Section  
(General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	131.0	114.5	159.0
6.3	132.5	116.0	158.0
8.0	134.0	118.0	157.0
10.0	135.5	120.0	156.0
12.5	136.5	121.5	155.0
16.0	138.0	123.0	154.0
20.0	139.0	124.5	153.0
25.0	140.0	126.0	152.0
31.5	141.5	127.5	151.0
40.0	142.0	129.0	150.0
50.0	143.0	130.5	148.0
63.0	144.0	131.0	146.0
80.0	144.5	132.0	144.0
100.0	145.0	133.0	142.0
125.0	145.5	134.0	140.0
160.0	145.5	134.0	138.0
200.0	146.0	134.5	136.0
250.0	146.0	134.5	134.0
315.0	146.0	134.5	132.0
400.0	145.5	134.5	130.0
500.0	145.5	134.5	128.0
630.0	145.0	134.0	126.0
800.0	144.5	134.0	124.0
1000.0	143.5	133.5	122.0
1250.0	143.0	133.5	120.0
1600.0	142.0	133.0	118.0
2000.0	141.0	132.5	116.0
2500.0	140.0	132.0	114.0
3150.0	139.5	131.5	112.0
4000.0	138.5	130.5	110.0
5000.0	137.5	130.0	108.0
6300.0	137.0	129.0	106.0
8000.0	136.0	128.5	104.0
10000.0	135.0	128.0	102.0
Overall SPL	158.0	147.0	165.5
Duration	1 min	2 min	N/A

Subzone 2-3 - ET LH<sub>2</sub> Tank Cylinder, Inboard (Orbiter) Side, Forward  
Section (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N}/\text{m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	139.0	159.0
6.3	131.5	140.0	158.0
8.0	133.0	141.0	157.0
10.0	134.5	142.5	156.0
12.5	135.5	143.5	155.0
16.0	137.0	144.5	154.0
20.0	138.0	145.0	153.0
25.0	139.0	146.0	152.0
31.5	140.0	146.0	151.0
40.0	141.0	146.0	150.0
50.0	142.0	147.0	148.0
63.0	142.5	147.0	146.0
80.0	142.5	147.0	144.0
100.0	143.0	147.0	142.0
125.0	143.5	147.0	140.0
160.0	143.5	147.0	138.0
200.0	143.5	147.0	136.0
250.0	143.5	147.0	134.0
315.0	143.0	146.0	132.0
400.0	143.0	145.0	130.0
500.0	142.5	144.0	128.0
630.0	142.0	144.0	126.0
800.0	141.5	144.0	124.0
1000.0	141.0	144.0	122.0
1250.0	140.0	144.0	120.0
1600.0	139.5	143.0	118.0
2000.0	138.5	142.0	116.0
2500.0	137.5	141.0	114.0
3150.0	137.0	140.0	112.0
4000.0	136.0	139.5	110.0
5000.0	135.0	138.5	108.0
6300.0	134.0	137.5	106.0
8000.0	133.0	136.5	104.0
10000.0	132.0	135.5	102.0
Overall SPL	155.5	159.5	165.5
Duration	1 min	2 min	N/A

Subzone 2-4 - ET LH<sub>2</sub> Tank Cylinder, Outboard Side, Forward Section  
(General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	114.5	159.0
6.3	131.5	116.0	158.0
8.0	133.0	118.0	157.0
10.0	134.5	120.0	156.0
12.5	135.5	121.5	155.0
16.0	137.0	123.0	154.0
20.0	138.0	124.5	153.0
25.0	139.0	126.0	152.0
31.5	140.0	127.5	151.0
40.0	141.0	129.0	150.0
50.0	142.0	130.5	148.0
63.0	142.5	131.0	146.0
80.0	142.5	132.0	144.0
100.0	143.0	133.0	142.0
125.0	143.5	134.0	140.0
160.0	143.5	134.0	138.0
200.0	143.5	134.5	136.0
250.0	143.5	134.5	134.0
315.0	143.0	134.5	132.0
400.0	143.0	134.5	130.0
500.0	142.5	134.5	128.0
630.0	142.0	134.0	126.0
800.0	141.5	134.0	124.0
1000.0	141.0	133.5	122.0
1250.0	140.0	133.5	120.0
1600.0	139.5	133.0	118.0
2000.0	138.5	132.5	116.0
2500.0	137.5	132.0	114.0
3150.0	137.0	131.5	112.0
4000.0	136.0	130.5	110.0
5000.0	135.0	130.0	108.0
6300.0	134.0	129.0	106.0
8000.0	133.0	128.5	104.0
10000.0	132.0	128.0	102.0
Overall SPL	155.5	147.0	165.5
Duration	1 min	2 min	N/A

# Zone 3 - ET Intertank Section (General Specifications)

## INTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	115.0	118.0	
6.3	116.5	119.0	
8.0	117.5	119.5	
10.0	119.0	120.5	N
12.5	120.0	121.0	
16.0	121.0	122.0	O
20.0	122.5	123.0	
25.0	123.5	123.5	T
31.5	129.0	129.0	
40.0	134.0	133.5	
50.0	134.5	134.0	
63.0	135.0	134.5	
80.0	135.5	134.5	A
100.0	135.5	135.0	
125.0	136.0	135.0	P
160.0	135.5	135.0	
200.0	135.5	134.5	P
250.0	135.5	134.5	
315.0	135.0	134.0	L
400.0	134.5	133.5	
500.0	132.5	131.5	I
630.0	130.5	129.5	
800.0	128.5	127.5	C
1000.0	127.0	125.0	
1250.0	124.0	122.5	A
1600.0	121.5	122.5	
2000.0	118.5	118.0	B
2500.0	115.5	115.0	
3150.0	112.5	112.0	L
4000.0	109.5	109.5	
5000.0	107.0	107.0	E
6300.0	104.0	104.5	
8000.0	101.0	101.5	
10000.0	98.0	98.5	
Overall SPL	146.5	145.5	
Duration	1 min	2 min	

Subzone 3-1 - ET Intertank Section, Panels 1, 2, and 3, Fwd of  $X_t = 985$ ,  
(General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N}/\text{m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	133.0	159.0
6.3	131.5	134.5	158.0
8.0	132.5	136.0	157.0
10.0	134.0	137.5	156.0
12.5	135.0	139.0	155.0
16.0	136.0	140.5	154.0
20.0	137.5	141.0	153.0
25.0	138.5	142.0	152.0
31.5	139.0	143.0	151.0
40.0	140.0	144.0	150.0
50.0	140.5	145.0	148.0
63.0	141.0	145.5	146.0
80.0	141.5	145.5	144.0
100.0	141.5	146.0	142.0
125.0	142.0	146.0	140.0
160.0	141.5	145.5	138.0
200.0	141.5	145.0	136.0
250.0	141.5	144.5	134.0
315.0	141.0	144.0	132.0
400.0	140.5	143.0	130.0
500.0	140.0	142.5	128.0
630.0	139.5	141.5	126.0
800.0	139.0	140.5	124.0
1000.0	138.0	139.0	122.0
1250.0	137.5	138.0	120.0
1600.0	136.5	137.0	118.0
2000.0	135.5	136.0	116.0
2500.0	134.5	135.0	114.0
3150.0	133.5	133.5	112.0
4000.0	132.5	132.0	110.0
5000.0	132.0	130.5	108.0
6300.0	131.0	129.0	106.0
8000.0	130.0	128.0	104.0
10000.0	129.0	126.5	102.0
Overall SPL	153.5	157.0	165.5
Duration	1 min	2 min	N/A

Subzone 3-1 - ET Intertank Section, Panels 1, 2, and 3, Aft of  $X_T = 985$   
(General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N}/\text{m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	139.0	159.0
6.3	131.5	139.5	158.0
8.0	132.5	140.5	157.0
10.0	134.0	141.5	156.0
12.5	135.0	142.0	155.0
16.0	136.0	142.5	154.0
20.0	137.5	143.0	153.0
25.0	138.5	144.0	152.0
31.5	139.0	145.0	151.0
40.0	140.0	145.5	150.0
50.0	140.5	146.0	148.0
63.0	141.0	147.0	146.0
80.0	141.5	148.0	144.0
100.0	141.5	149.0	142.0
125.0	142.0	147.0	140.0
160.0	141.5	147.0	138.0
200.0	141.5	146.0	136.0
250.0	141.5	146.0	134.0
315.0	141.0	145.0	132.0
400.0	140.5	144.0	130.0
500.0	140.0	143.0	128.0
630.0	139.5	143.0	126.0
800.0	139.0	142.0	124.0
1000.0	138.0	141.0	122.0
1250.0	137.5	141.0	120.0
1600.0	136.5	140.0	118.0
2000.0	135.5	139.0	116.0
2500.0	134.5	138.0	114.0
3150.0	133.5	137.0	112.0
4000.0	132.5	136.0	110.0
5000.0	132.0	135.0	108.0
6300.0	131.0	134.0	106.0
8000.0	130.0	133.0	104.0
10000.0	129.0	132.0	102.0
Overall SPL	153.5	159.0	165.5
Duration	1 min	2 min	N/A



Subzone 3-2 - ET Intertank Section, Panels 4 and 5 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Lift-off	In-flight Fluctuating Pressure	Oscillating Shock
5.0	130.0	144.0	159.0
6.3	131.5	145.0	158.0
8.0	132.5	147.0	157.0
10.0	134.0	148.5	156.0
12.5	135.0	149.0	155.0
16.0	136.0	150.5	154.0
20.0	137.5	150.0	153.0
25.0	138.5	153.0	152.0
31.5	139.0	154.0	151.0
40.0	140.0	154.5	150.0
50.0	140.5	155.0	148.0
63.0	141.0	155.5	146.0
80.0	141.5	156.0	144.0
100.0	141.5	156.5	142.0
125.0	142.0	156.5	140.0
160.0	141.5	156.0	138.0
200.0	141.5	156.0	136.0
250.0	141.5	156.0	134.0
315.0	141.0	155.5	132.0
400.0	140.5	155.0	130.0
500.0	140.0	154.5	128.0
630.0	139.5	154.0	126.0
800.0	139.0	153.0	124.0
1000.0	138.0	152.0	122.0
1250.0	137.5	151.5	120.0
1600.0	136.5	150.5	118.0
2000.0	135.5	149.5	116.0
2500.0	134.5	148.5	114.0
3150.0	133.5	147.0	112.0
4000.0	132.5	146.5	110.0
5000.0	132.0	145.0	108.0
6300.0	131.0	144.0	106.0
8000.0	130.0	143.0	104.0
10000.0	129.0	141.5	102.0
Overall SPL	153.5	168.5	165.5
Dur.     n	1 min	2 min	N/A

Subzone 3-3 - ET Intertank Section, Panels 6, 7, and 8 (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	130.5	159.0
6.3	131.5	132.0	158.0
8.0	132.5	133.0	157.0
10.0	134.0	134.0	156.0
12.5	135.0	135.0	155.0
16.0	136.0	136.5	154.0
20.0	137.5	137.0	153.0
25.0	138.5	138.5	152.0
31.5	139.0	138.5	151.0
40.0	140.0	139.0	150.0
50.0	140.5	139.5	148.0
63.0	141.0	140.0	146.0
80.0	141.5	140.5	144.0
100.0	141.5	141.0	142.0
125.0	142.0	141.0	140.0
160.0	141.5	141.0	138.0
200.0	141.5	140.5	136.0
250.0	141.5	140.5	134.0
315.0	141.0	139.5	132.0
400.0	140.5	139.0	130.0
500.0	140.0	139.0	128.0
630.0	139.5	138.5	126.0
800.0	139.0	138.0	124.0
1000.0	138.0	137.5	122.0
1250.0	137.5	137.0	120.0
1600.0	136.5	136.0	118.0
2000.0	135.5	135.5	116.0
2500.0	134.5	135.0	114.0
3150.0	133.5	134.0	112.0
4000.0	132.5	133.0	110.0
5000.0	132.0	132.5	108.0
6300.0	131.0	131.5	106.0
8000.0	130.0	131.0	104.0
10000.0	129.0	130.0	102.0
Overall SPL	153.5	153.0	165.5
Duration	1 min	2 min	N/A

# Zone 4 - ET LOX Tank Cylindrical Section (General Specifications)

## EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	138.0	159.0
6.3	131.5	139.0	158.0
8.0	132.5	139.5	157.0
10.0	134.0	140.5	156.0
12.5	135.0	141.0	155.0
16.0	136.0	142.0	154.0
20.0	137.5	143.0	153.0
25.0	138.5	144.0	152.0
31.5	139.0	144.5	151.0
40.0	140.0	145.0	150.0
50.0	140.5	145.5	148.0
63.0	141.0	146.0	146.0
80.0	141.5	146.5	144.0
100.0	141.5	147.0	142.0
125.0	142.0	147.0	140.0
160.0	141.5	147.5	138.0
200.0	141.5	147.5	136.0
250.0	141.5	147.5	134.0
315.0	141.0	147.5	132.0
400.0	140.5	147.5	130.0
500.0	140.0	147.5	128.0
630.0	139.5	147.5	126.0
800.0	139.0	147.0	124.0
1000.0	138.0	147.0	122.0
1250.0	137.5	146.0	120.0
1600.0	136.5	145.5	118.0
2000.0	135.5	145.0	116.0
2500.0	134.5	144.0	114.0
3150.0	133.5	143.0	112.0
4000.0	132.5	141.5	110.0
5000.0	132.0	140.5	108.0
6300.0	131.0	139.0	106.0
8000.0	130.0	138.0	104.0
10000.0	129.0	137.0	102.0
Overall SPL	153.5	130.5	165.5
Duration	1 min	2 min	N/A

Zone 5-1 - ET Ogive and Nose Cap (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	120.0	159.0
6.3	131.5	121.0	158.0
8.0	132.5	122.0	157.0
10.0	134.0	123.5	156.0
12.5	135.0	125.0	155.0
15.0	136.0	126.0	154.0
20.0	137.5	127.0	153.0
25.0	138.5	128.0	152.0
31.5	139.0	129.0	151.0
40.0	140.0	130.0	150.0
50.0	140.5	131.0	148.0
63.0	141.0	132.0	146.0
80.0	141.5	133.0	144.0
100.0	141.5	134.0	142.0
125.0	142.0	135.0	140.0
160.0	141.5	136.0	138.0
200.0	141.5	136.5	136.0
250.0	141.5	137.0	134.0
315.0	141.0	137.5	132.0
400.0	140.5	138.0	130.0
500.0	140.0	138.0	128.0
630.0	139.5	138.0	126.0
800.0	139.0	138.0	124.0
1000.0	138.0	137.5	122.0
1250.0	137.5	137.0	120.0
1600.0	136.5	136.5	118.0
2000.0	135.5	136.0	116.0
2500.0	134.5	135.5	114.0
3150.0	133.5	135.0	112.0
4000.0	132.5	134.0	110.0
5000.0	132.0	133.0	108.0
6300.0	131.0	132.0	106.0
8000.0	130.0	131.0	104.0
10000.0	129.0	130.0	102.0
Overall SPL	153.5	149.5	165.5
Duration	1 min	2 min	N/A

# Zone 5-2 - ET Ogive and Nose Cap (General Specifications)

## EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu\text{N}/\text{m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	115.0	159.0
6.3	131.5	117.0	158.0
8.0	132.5	118.0	157.0
10.0	134.0	119.5	156.0
12.5	135.0	121.0	155.0
16.0	136.0	122.0	154.0
20.0	137.5	123.5	153.0
25.0	138.5	124.5	152.0
31.5	139.0	125.5	151.0
40.0	140.0	126.5	150.0
50.0	140.5	127.5	148.0
63.0	141.0	128.5	146.0
80.0	141.5	129.5	144.0
100.0	141.5	130.0	142.0
125.0	142.0	130.5	140.0
160.0	141.5	131.0	138.0
200.0	141.5	131.5	136.0
250.0	141.5	132.0	134.0
315.0	141.0	132.0	132.0
400.0	140.5	132.5	130.0
500.0	140.0	132.5	128.0
630.0	139.5	132.5	126.0
800.0	139.0	132.0	124.0
1000.0	138.0	132.0	122.0
1250.0	137.5	132.0	120.0
1600.0	136.5	131.5	118.0
2000.0	135.5	131.5	116.0
2500.0	134.5	131.5	114.0
3150.0	133.5	131.0	112.0
4000.0	132.5	131.0	110.0
5000.0	132.0	131.0	108.0
6300.0	131.0	130.5	106.0
8000.0	130.0	130.0	104.0
10000.0	129.0	130.0	102.0
Overall SPL	153.5	145.0	165.5
Duration	1 min	2 min	N/A

Zone 5-3-1 ET Ogive and Nose Cap (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re 20  $\mu$ N/m<sup>2</sup>)

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	127.0	159.0
6.3	131.5	129.0	158.0
8.0	132.5	131.0	157.0
10.0	134.0	133.0	156.0
12.5	135.0	135.0	155.0
16.0	136.0	137.0	154.0
20.0	137.5	139.0	153.0
25.0	138.5	141.0	152.0
31.5	139.0	142.5	151.0
40.0	140.0	144.0	150.0
50.0	140.5	145.5	148.0
63.0	141.0	147.0	146.0
80.0	141.5	148.0	144.0
100.0	141.5	149.0	142.0
125.0	142.0	150.0	140.0
160.0	141.5	150.5	138.0
200.0	141.5	151.0	136.0
250.0	141.5	151.5	134.0
315.0	141.0	152.0	132.0
400.0	140.5	152.0	130.0
500.0	140.0	151.5	128.0
630.0	139.5	151.0	126.0
800.0	139.0	150.5	124.0
1000.0	138.0	150.0	122.0
1250.0	137.5	149.5	120.0
1600.0	136.5	149.0	118.0
2000.0	135.5	148.5	116.0
2500.0	134.5	147.5	114.0
3150.0	133.5	146.5	112.0
4000.0	132.5	145.5	110.0
5000.0	132.0	144.5	108.0
6300.0	131.0	143.5	106.0
8000.0	130.0	142.5	104.0
10000.0	129.0	141.5	102.0
Overall SPL	153.5	163.0	165.5
Duration	1 min	2 min	N/A

Zone 5-3-2 ET Ogive and Nose Cap (General Specifications)

EXTERNAL

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

<u>Geometric Mean Frequency (Hz)</u>	<u>Lift-off</u>	<u>In-flight Fluctuating Pressure</u>	<u>Oscillating Shock</u>
5.0	130.0	127.5	159.0
6.3	131.5	129.0	158.0
8.0	132.5	131.0	157.0
10.0	134.0	132.5	156.0
12.5	135.0	134.0	155.0
16.0	136.0	135.0	154.0
20.0	137.5	137.0	153.0
25.0	138.5	138.0	152.0
31.5	139.0	139.5	151.0
40.0	140.0	140.5	150.0
50.0	140.5	142.0	148.0
63.0	141.0	143.0	146.0
80.0	141.5	144.0	144.0
100.0	141.5	145.0	142.0
125.0	142.0	146.0	140.0
160.0	141.5	146.5	138.0
200.0	141.5	147.0	136.0
250.0	141.5	147.0	134.0
315.0	141.0	148.0	132.0
400.0	140.5	148.0	130.0
500.0	140.0	148.0	128.0
630.0	139.5	148.0	126.0
800.0	139.0	147.5	124.0
1000.0	138.0	147.0	122.0
1250.0	137.5	146.5	120.0
1600.0	136.5	146.0	118.0
2000.0	135.5	145.5	116.0
2500.0	134.5	145.0	114.0
3150.0	133.5	144.0	112.0
4000.0	132.5	143.0	110.0
5000.0	132.0	142.5	108.0
6300.0	131.0	141.0	106.0
8000.0	130.0	140.0	104.0
10000.0	129.0	139.0	102.0
Overall SPL	153.5	159.5	165.5
Duration	1 min	2 min	N/A

# PROTUBERANCE

## IN-FLIGHT FLUCTUATING PRESSURE

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Protuberance ZONE A	Protuberance ZONE B	Protuberance ZONE C	Protuberance ZONE D
5.0	139.0	139.0	133.0	139.0
6.3	140.0	140.0	134.5	139.5
8.0	140.5	141.0	136.0	140.5
10.0	141.5	142.5	137.5	141.5
12.5	142.0	143.5	139.0	142.0
16.0	142.5	144.5	140.5	142.5
20.0	142.5	145.0	141.0	143.0
25.0	143.0	146.0	142.0	144.0
31.5	144.0	146.0	143.0	145.0
40.0	145.0	146.0	144.0	145.5
50.0	146.0	147.0	145.0	146.0
63.0	146.5	147.0	145.5	147.0
80.0	147.0	147.0	145.5	148.0
100.0	147.5	147.0	146.0	148.0
125.0	148.5	148.5	147.0	149.0
160.0	151.0	151.0	152.0	151.0
200.0	152.0	152.0	151.0	152.0
250.0	152.0	152.0	150.0	152.0
315.0	150.0	150.0	146.0	150.0
400.0	148.0	149.0	146.0	149.0
500.0	148.0	148.0	145.0	148.0
630.0	148.0	148.0	145.0	148.0
800.0	147.5	147.5	146.0	147.0
1000.0	146.5	146.5	146.0	146.0
1250.0	145.5	145.5	144.0	145.0
1600.0	145.0	145.0	143.0	145.0
2000.0	144.5	144.5	142.0	144.0
2500.0	143.5	143.5	140.5	143.0
3150.0	142.5	142.5	139.0	142.0
4000.0	142.0	141.5	137.0	140.5
5000.0	141.0	140.5	135.0	139.5
6300.0	140.0	139.5	133.0	138.5
8000.0	139.0	138.5	131.0	137.5
10000.0	138.5	137.5	129.0	136.0
Overall SPL	161.5	162.0	160.0	161.5

Protuberance Zone A: Criteria are applicable to  $\text{GO}_2$  pressure line/cable tray installation  $\pm 10^\circ$  in zone 2-1.

Protuberance Zone B: Criteria are applicable to  $\text{GO}_2$  pressure line/cable tray installation  $\pm 10^\circ$  in zone 2-3.

Protuberance Zone C: Criteria are applicable to  $\text{GO}_2$  pressure line/cable tray installation  $\pm 10^\circ$  in zone 3-1, Fwd of  $X_T$  - 985.

Protuberance Zone D: Criteria are applicable to  $\text{GO}_2$  pressure line/cable tray installation  $\pm 10^\circ$  in zone 3-1, Aft of  $X_T$  = 985.



## PROTUBERANCE

### IN-FLIGHT FLUCTUATING PRESSURE

(One-third Octave Band Acoustic Specification in dB re  $20 \mu\text{N/m}^2$ )

Geometric Mean Frequency (Hz)	Protuberance ZONE E	Protuberance ZONE F	Protuberance ZONE G	Protuberance ZONE H
5.0	132.5	140.0	142.5	137.0
6.3	133.0	143.0	144.0	139.0
8.0	133.5	146.0	146.5	141.0
10.0	134.0	149.0	148.0	143.5
12.5	134.5	151.5	149.0	145.0
16.0	135.5	153.5	150.0	147.5
20.0	136.0	167.0	151.5	149.0
25.0	137.0	168.0	153.0	150.0
31.0	137.0	168.0	154.0	151.0
40.0	138.0	170.0	155.0	152.0
50.0	138.0	160.0	156.0	153.0
63.0	140.0	154.0	156.5	153.5
80.0	141.5	154.0	157.0	154.0
100.0	144.0	153.5	157.5	154.0
125.0	147.0	153.0	158.0	154.0
160.0	152.0	152.5	158.5	154.0
200.0	151.0	152.0	159.0	153.5
250.0	150.0	151.5	159.0	153.0
315.0	146.0	151.0	159.0	152.5
400.0	146.0	150.0	158.5	152.0
500.0	145.0	149.0	158.0	151.5
630.0	145.0	148.0	157.5	151.0
800.0	146.0	147.0	157.0	150.0
1000.0	146.0	146.0	156.5	149.0
1250.0	144.0	145.0	156.0	148.0
1600.0	143.0	144.0	155.0	147.0
2000.0	142.0	143.0	154.0	146.0
2500.0	141.0	142.0	153.0	145.0
3150.0	140.0	141.0	152.0	144.0
4000.0	138.5	140.0	151.0	143.0
5000.0	137.0	139.0	150.0	142.0
6300.0	136.0	138.0	149.0	141.0
8000.0	134.5	137.0	148.0	140.0
10000.0	133.0	136.0	147.0	139.0
Overall SPL	159.5	175.0	170.5	165.5

Protuberance Zone E: Criteria are applicable to  $\text{GO}_2$  pressure line/cable tray  $\pm 10^\circ$  in zones 4, 5-1, and 5-2.

Protuberance Zone F: Criteria are applicable to forward SRB attach  $\pm 10^\circ$  between  $X_T = 985$  and  $X_T = 1300$ .

Protuberance Zone G: Criteria are applicable to forward orbiter attach  $\pm 5^\circ$  between  $X_T = 1100$  and  $X_T = 1200$ .

Protuberance Zone H: Criteria are applicable to aft attach cross beam.

## SECTION V. SPECIFICATIONS FOR SPECIFIC COMPONENTS

### Input to Components Mounted on the Mated Ground Umbilical Carrier Plate in the Intertank (Pre-Separation)

#### 1. Acceptance Test Criteria (1 minute/axis)

##### Radial Axis

20 Hz @  $0.0025 \text{ g}^2/\text{Hz}$   
20 - 39 Hz @ +6 dB/oct  
39 - 800 Hz @  $0.0095 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0015 \text{ g}^2/\text{Hz}$

Composite =  $3.5 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.0005$   
20 - 37 Hz @ +9 dB/oct  
37 - 170 Hz @  $0.003 \text{ g}^2/\text{Hz}$   
170 - 310 Hz @ +6 dB/oct  
310 - 800 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0016 \text{ g}^2/\text{Hz}$

Composite =  $3.3 \text{ g}_{\text{rms}}$

#### 2. Pre-Liftoff Random Vibration Criteria (1 minute/axis)

##### Radial Axis

20 Hz @  $0.01 \text{ g}^2/\text{Hz}$   
20 - 39 Hz @ +6 dB/oct  
39 - 800 Hz @  $0.038 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0061 \text{ g}^2/\text{Hz}$

Composite =  $6.9 \text{ g}_{\text{rms}}$

##### Long. and Tang. Axes

20 Hz @  $0.002 \text{ g}^2/\text{Hz}$   
20 - 37 Hz @ +9 dB/oct  
37 - 170 Hz @  $0.012 \text{ g}^2/\text{Hz}$   
170 - 310 Hz @ +6 dB/oct  
310 - 800 Hz @  $0.04 \text{ g}^2/\text{Hz}$   
800 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.0064 \text{ g}^2/\text{Hz}$

Composite =  $6.6 \text{ g}_{\text{rms}}$

#### 3. Boost Random Vibration Criteria

N/A

#### 4. Vehicle Dynamics Criteria

N/A

#### 5. Shock Test Criteria

See Table I

## Input to Range Safety Panel

### 1. Acceptance Test Criteria (1 min/axis)

#### Radial Axis

20 Hz @  $0.033 \text{ g}^2/\text{Hz}$   
20 - 43 Hz @ +9 dB/oct  
43 - 100 Hz @  $0.33 \text{ g}^2/\text{Hz}$   
100 - 123 Hz @ -9 dB/oct  
123 - 400 Hz @  $0.175 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.007 \text{ g}^2/\text{Hz}$

Composite =  $11.5 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 Hz @  $0.00065 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +9 dB/oct  
60 - 1300 Hz @  $0.018 \text{ g}^2/\text{Hz}$   
1300 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.0048 \text{ g}^2/\text{Hz}$

Composite =  $5.3 \text{ g}_{\text{rms}}$

### 2 and 3. Flight Random Vibration Criteria (3 min/axis)

#### Radial Axis

20 Hz @  $0.13 \text{ g}^2/\text{Hz}$   
20 - 43 Hz @ +9 dB/oct  
43 - 100 Hz @  $1.3 \text{ g}^2/\text{Hz}$   
100 - 123 Hz @ -9 dB/oct  
123 - 400 Hz @  $0.7 \text{ g}^2/\text{Hz}$   
400 - 2000 Hz @ -6 dB/oct  
2000 Hz @  $0.028 \text{ g}^2/\text{Hz}$

Composite =  $23.0 \text{ g}_{\text{rms}}$

#### Long. and Tang. Axes

20 Hz @  $0.0026 \text{ g}^2/\text{Hz}$   
20 - 60 Hz @ +9 dB/oct  
60 - 1300 Hz @  $0.07 \text{ g}^2/\text{Hz}$   
1300 - 2000 Hz @ -9 dB/oct  
2000 Hz @  $0.09 \text{ g}^2/\text{Hz}$

Composite =  $10.7 \text{ g}_{\text{rms}}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria

See Table I

\* Design Criteria Only

## Input to Components on ET Isolated RSS Panel

### 1. Acceptance Test Criteria (3 min/axis)

#### Radial Axis

20 Hz @ 0.5  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 1.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.15  $g^2/Hz$   
136 - 200 Hz @ -18 dB/oct  
200 - 1000 Hz @ 0.015  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0038  $g^2/Hz$

Composite = 7.76  $g_{rms}$

#### Long. and Tang. Axes

20 - 40 Hz @ 0.033  $g^2/Hz$   
40 - 86 Hz @ -9 dB/oct  
86 - 1300 Hz @ 0.0033  $g^2/Hz$   
1300 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0006  $g^2/Hz$

Composite = 2.5  $g_{rms}$

### 2 and 3. Flight Random Vibration Criteria (L.0 and Boost 3 min/axis)

#### Radial Axis

20 Hz @ 2.0  $g^2/Hz$   
20 - 25 Hz @ +9 dB/oct  
25 - 40 Hz @ 4.0  $g^2/Hz$   
40 - 55 Hz @ -18 dB/oct  
55 - 136 Hz @ 0.6  $g^2/Hz$   
136 - 200 Hz @ -18 dB/oct  
200 - 1000 Hz @ 0.06  $g^2/Hz$   
1000 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.015  $g^2/Hz$

Composite = 15.52  $g_{rms}$

#### Long. and Tang. Axes

20 - 40 Hz @ 0.133  $g^2/Hz$   
40 - 86 Hz @ -9 dB/oct  
86 - 1300 Hz @ 0.0133  $g^2/Hz$   
1300 - 2000 Hz @ -12 dB/oct  
2000 Hz @ 0.0024  $g^2/Hz$

Composite = 5.0  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria

See Table I

\* Design Criteria Only.

## Input to Linear Shaped Charge in Cable Tray

### 1. Acceptance Test Criteria (3 min/axis)

#### Radial Axis

20 Hz @ 0.045  $g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 52 Hz @ 0.10  $g^2/Hz$   
52 - 96 Hz @ +9 dB/oct  
96 - 250 Hz @ 0.625  $g^2/Hz$   
250 - 330 Hz @ -10 dB/oct  
330 - 795 Hz @ 0.25  $g^2/Hz$   
795 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.0375  $g^2/Hz$

Composite = 19.6

#### Long. and Tang. Axes

20 Hz @ 0.0093  $g^2/Hz$   
20 - 48 Hz @ +4 dB/oct  
48 - 109 Hz @ 0.03  $g^2/Hz$   
109 - 128 Hz @ +10 dB/oct  
128 - 940 Hz @ 0.05  $g^2/Hz$   
940 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.011  $g^2/Hz$

Composite = 8.3

### 2 and 3. Flight Random Vibration Criteria (3 min/axis)

#### Radial Axis

20 Hz @ 0.18  $g^2/Hz$   
20 - 30 Hz @ +6 dB/oct  
30 - 52 Hz @ 0.4  $g^2/Hz$   
52 - 96 Hz @ +9 dB/oct  
96 - 250 Hz @ 2.5  $g^2/Hz$   
250 - 330 Hz @ -10 dB/oct  
330 - 795 Hz @ 1.0  $g^2/Hz$   
795 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.15  $g^2/Hz$

Composite = 39.2  $g_{rms}$

#### Long. and Tang. Axes

20 Hz @ 0.037  $g^2/Hz$   
20 - 48 Hz @ +4 dB/oct  
48 - 109 Hz @ 0.12  $g^2/Hz$   
109 - 128 Hz @ +10 dB/oct  
128 - 940 Hz @ 0.20  $g^2/Hz$   
940 - 2000 Hz @ -6 dB/oct  
2000 Hz @ 0.044  $g^2/Hz$

Composite = 16.6  $g_{rms}$

### 4. Vehicle Dynamics Criteria

#### Longitudinal Axis

2 - 5 Hz @ 0.6 G's peak\*  
5 - 40 Hz @ 0.6 G's peak

#### Lateral Axes

2 - 5 Hz @ 0.8 G's peak\*  
5 - 40 Hz @ 0.8 G's peak

### 5. Shock Test Criteria

See Table I

\* Design Criteria Only.

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PART IV

VIBRATION, ACOUSTIC, AND SHOCK

DESIGN AND TEST CRITERIA

FOR

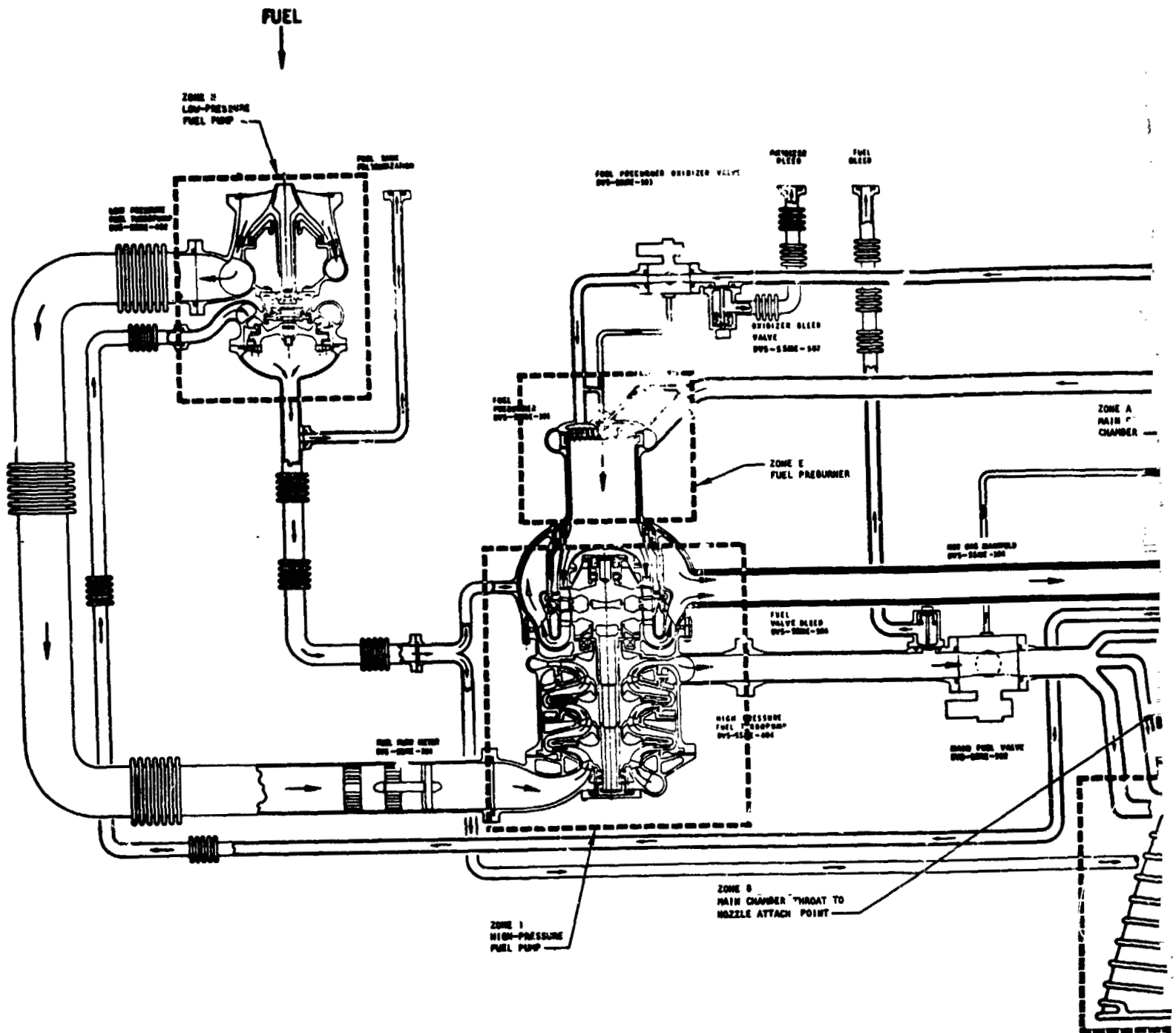
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FOLDOUT FRAME

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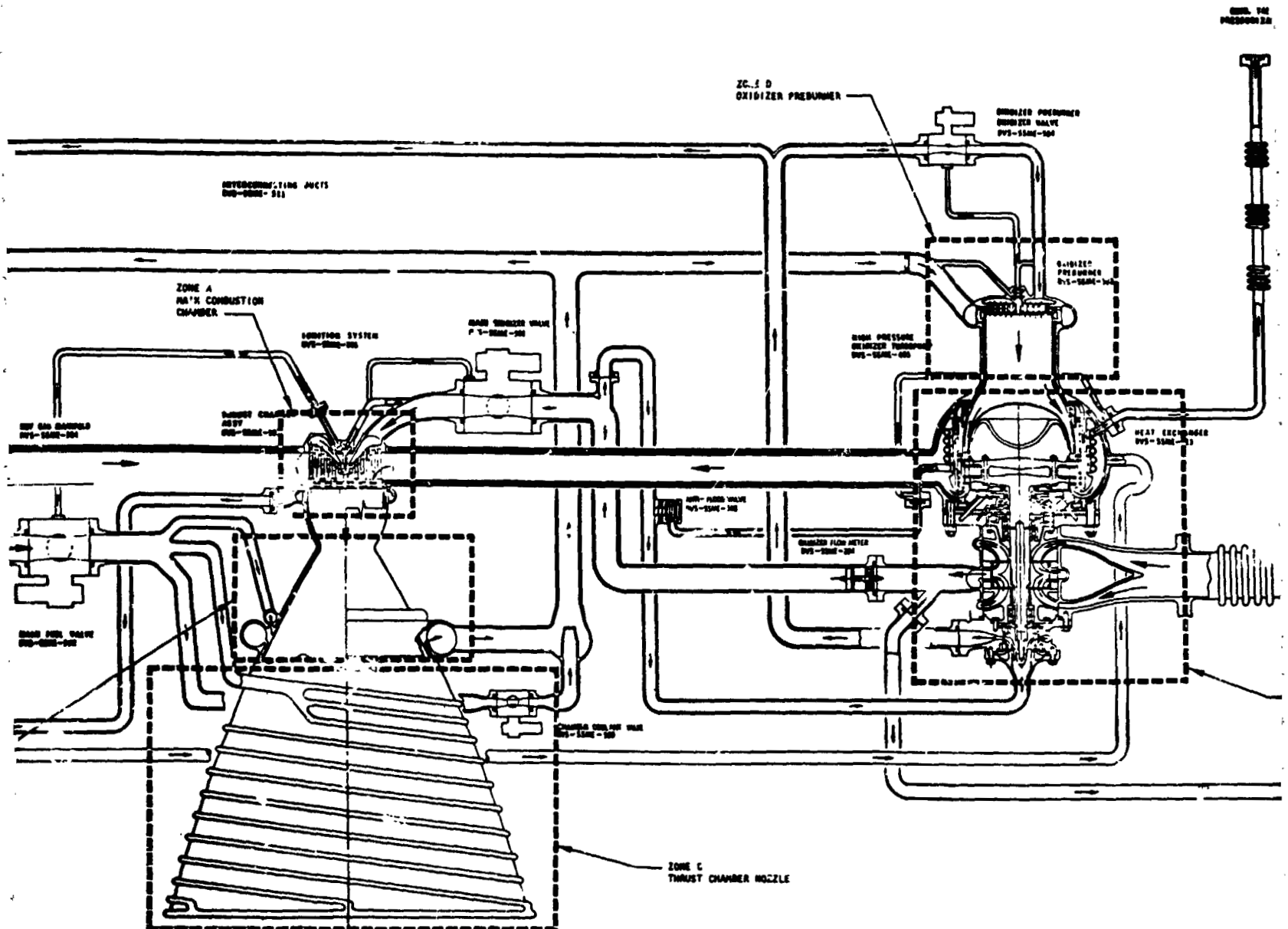


Figure 4-1. Major Sources of

2 FOLDOUT FRAME

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## SECTION II. VIBRATION AND SHOCK SPECIFICATIONS

(Zone A)

### Major Sources of Vibrations — Zones A Through I

#### 4.5.1 SSME Vibration Criteria Zone A

This zone includes the main combustion chamber (MCC), the injector, the dome, and the igniter and auxillary spark igniter (ASI) chamber. Vibration amplitudes are as follows.

Transient shock spectrum-R1: (Engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
20 Hz @ 40.0 g peak  
800 Hz @ 60.0 g peak  
2000 Hz @ 150.0 g peak

Parallel to the engine centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 460 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$   
460 - 700 Hz @ +12.50 dB/oct  
700 - 920 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
920 - 1000 Hz @ -25.02 dB/oct  
1000 - 1200 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
1200 - 1300 Hz @ +26.07 dB/oct  
1300 - 1600 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
1600 - 1800 Hz @ +66.99 dB/oct  
1800 - 2000 Hz @  $0.55 (g \text{ rms})^2/\text{Hz}$

(Zone A)

Random composite reference level = 13.70 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.0 g rms at 500 Hz and 2.5 g rms at 600 Hz for 6.5 hr

Sinusoidal sweep of 2.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr

Total composite level = 14.10 g rms

Perpendicular to engine center line (engine Y axis)

Steady-state random vibration amplitudes-R4:

20	-	150 Hz @ 0.007 (g rms) <sup>2</sup> /Hz
150	-	230 Hz @ +7.03 dB/oct
230	-	280 Hz @ 0.019 (g rms) <sup>2</sup> /Hz
280	-	300 Hz @ -10.31 dB/oct
300	-	360 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
360	-	380 Hz @ -22.58 dB/oct
380	-	510 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
510	-	700 Hz @ +13.18 dB/oct
700	-	820 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
820	-	910 Hz @ +2.76 dB/oct
910	-	1100 Hz @ 0.044 (g rms) <sup>2</sup> /Hz
1100	-	1140 Hz @ -16.91 dB/oct
1140	-	1210 Hz @ 0.036 (g rms) <sup>2</sup> /Hz
1210	-	1320 Hz @ +14.03 dB/oct
1320	-	1370 Hz @ 0.054 (g rms) <sup>2</sup> /Hz
1370	-	1410 Hz @ -31.39 dB/oct
1410	-	1510 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
1510	-	1680 Hz @ +22.88 dB/Hz
	-	1680 @ 0.09 (g rms) <sup>2</sup> /Hz
1680	-	1800 Hz @ +78.98 dB/oct
1800	-	2000 Hz @ 0.55 (g rms) <sup>2</sup> /Hz

(Zone A)

Random composite reference level = 13.99 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.9 g rms at 250 Hz, 2.0 g rms at 500 Hz, 2.5 g rms at 600 Hz, 1.3 g rms at 1000 Hz, and 4.9 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 2.5 g rms from 200 Hz to 1040 Hz to 200 Hz at 340 Hz/min and 4.9 g rms from 1400 Hz to 2000 Hz at 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 15.25 g rms

Tangential to engine centerline (engine Z axis)

Steady-state random vibration amplitudes-R4:

20	-	200 Hz	@	0.007 (g rms) <sup>2</sup> /Hz
200	-	270 Hz	@	+12.77 dB/oct
270	-	290 Hz	@	0.025 (g rms) <sup>2</sup> /Hz
290	-	430 Hz	@	-5.61 dB/oct
430	-	540 Hz	@	0.012 (g rms) <sup>2</sup> /Hz
540	-	700 Hz	@	+13.97 dB/oct
700	-	920 Hz	@	0.04 (g rms) <sup>2</sup> /Hz
920	-	990 Hz	@	+2.97 dB/oct
990	-	1070 Hz	@	0.043 (g rms) <sup>2</sup> /Hz
1070	-	1120 Hz	@	-11.71 dB/oct
1120	-	1180 Hz	@	0.036 (g rms) <sup>2</sup> /Hz
1180	-	1290 Hz	@	+9.72 dB/oct
1290	-	1370 Hz	@	0.048 (g rms) <sup>2</sup> /Hz
1370	-	1420 Hz	@	+41.84 dB/oct
1420	-	1490 Hz	@	0.079 (g rms) <sup>2</sup> /Hz
1490	-	1510 Hz	@	-65.90 dB/oct
1510	-	1540 Hz	@	0.059 (g rms) <sup>2</sup> /Hz
1540	-	1800 Hz	@	+43.08 dB/oct
1800	-	2000 Hz	@	0.55 (g rms) <sup>2</sup> /Hz

(Zone A)

Random composite reference level = 14.78 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.0 g rms at 500 Hz, 2.5 g rms at 600 Hz, 1.1 g rms at 1000 Hz and 3.8 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 2.5 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 3.8 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 15.64 g rms.

(Zone A-1)

#### 4.5.1.1 SSME Vibration Criteria Zone A-1

This zone includes the main combustion chamber (MCC) PC offset mount. Vibration amplitudes (based on DVS testing representing accumulated engine FPL operation time) are:

##### Tangential direction (component X axis)

##### Steady-state random vibration-R4:

20	-	110 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
110	-	200 Hz @ 6.78 dB/oct
200	-	350 Hz @ 0.5 (g rms) <sup>2</sup> /Hz
350	-	410 Hz @ -53.53 dB/oct
410	-	520 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
520	-	560 Hz @ 28.16 dB/oct
560	-	610 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
610	-	620 Hz @ 321.13 dB/oct
620	-	630 Hz @ 0.34 (g rms) <sup>2</sup> /Hz
630	-	640 Hz @ -66.58 dB/oct
640	-	680 Hz @ 0.24 (g rms) <sup>2</sup> /Hz
680	-	820 Hz @ -37.03 dB/oct
820	-	850 Hz @ 0.024 (g rms) <sup>2</sup> /Hz
850	-	930 Hz @ 67.43 dB/oct
930	-	950 Hz @ 0.18 (g rms) <sup>2</sup> /Hz
950	-	1040 Hz @ -42.60 dB/oct
1040	-	1090 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
1090	-	1200 Hz @ 38.32 dB/oct
1200	-	1490 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
1490	-	1500 Hz @ 95.10 dB/oct
1500	-	2000 Hz @ 0.21 (g rms) <sup>2</sup> /Hz



(Zone A-1)

Random composite reference level = 18.72 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.2 g rms at 500 Hz, 1.3 g rms at 600 Hz, 1.5 g rms at 1200 Hz and 3.2 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.5 g rms from 350 Hz (MPL) to 620 Hz (FPL) to 350 Hz (MPL) at 270 Hz/min and 3.2 g rms from 1400 Hz (MPL) to 2000 Hz (FPL) to 1400 Hz (MPL) at 600 Hz/min for 1.0 hr.

Total composite level = 19.55 g rms

Radial direction (component Y axis)

Steady-state random vibration-R4:

20 -	200 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
200 -	240 Hz @ 36.28 dB/oct
240 -	260 Hz @ 0.27 (g rms) <sup>2</sup> /Hz
260 -	420 Hz @ -16.34 dB/oct
420 -	540 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
540 -	570 Hz @ 46.37 dB/oct
570 -	610 Hz @ 0.046 (g rms) <sup>2</sup> /Hz
610 -	630 Hz @ 96.94 dB/oct
630 -	680 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
680 -	720 Hz @ -62.07 dB/oct
720 -	780 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
780 -	800 Hz @ 82.42 dB/oct
800 -	880 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
880 -	950 Hz @ -27.26 dB/oct
950 -	1050 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
1050 -	1290 Hz @ 29.47 dB/oct
1290 -	1370 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1370 -	1450 Hz @ 58.27 dB/oct
1450 -	1590 Hz @ 0.9 (g rms) <sup>2</sup> /Hz
1590 -	1640 Hz @ -39.42 dB/oct
1640 -	1760 Hz @ 0.6 (g rms) <sup>2</sup> /Hz
1760 -	1800 Hz @ -92.85 dB/oct
1800 -	2000 Hz @ 0.3 (g rms) <sup>2</sup> /Hz

(Zone A-1)

Random composite level = 21.81 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.1 g rms at 500 Hz, 1.3 g rms at 600 Hz, 1.1 g rms at 1000 Hz and 3.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 1.3 g rms from 350 Hz (MPL) to 620 Hz (FPL) to 350 Hz (MPL) at 270 Hz/min and 3.5 g rms from 1400 Hz (MPL) to 2000 Hz (FPL) to 1400 Hz (MPL) at 600 Hz/min for 1.0 hr.

Total composite level = 22.18 g rms

Longitudinal direction (component Z axis)

Steady-state random vibration-R4:

20 -	250 Hz @	$0.03 (g \text{ rms})^2/\text{Hz}$
250 -	310 Hz @	9.70 dB/oct
310 -	440 Hz @	$0.06 (g \text{ rms})^2/\text{Hz}$
440 -	450 Hz @	-24 dB/oct
450 -	970 Hz @	$0.05 (g \text{ rms})^2/\text{Hz}$
970 -	1140 Hz @	38.76 dB/oct
1140 -	1350 Hz @	$0.4 (g \text{ rms})^2/\text{Hz}$
1350 -	1400 Hz @	67.12 dB/oct
1400 -	1520 Hz @	$0.9 (g \text{ rms})^2/\text{Hz}$
1520 -	1550 Hz @	50.60 dB/oct
1550 -	1580 Hz @	$1.25 (g \text{ rms})^2/\text{Hz}$
1580 -	1700 Hz @	-30.19 dB/oct
1700 -	1750 Hz @	$0.6 (g \text{ rms})^2/\text{Hz}$
1750 -	1770 Hz @	135.32 dB/oct
1770 -	1830 Hz @	$1.0 (g \text{ rms})^2/\text{Hz}$
1830 -	1890 Hz @	-150.18 dB/oct
1890 -	2000 Hz @	$0.2 (g \text{ rms})^2/\text{Hz}$

(Zone A-1)

Random composite reference level = 25.08 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.4 g rms at 500 Hz, 3.2 g rms at 600 Hz, 0.9 g rms at 1000 Hz and 2.6 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.2 g rms from 350 Hz (MPL) to 620 Hz (FPL) to 350 Hz (MPL) at 270 Hz/min and 2.6 g rms from 1400 Hz (MPL) to 2000 Hz (FPL) to 1400 Hz (MPL) at 600 Hz/min for 1.0 hr.

#### 4.5.2 SSME Vibration Criteria Zone B

This zone includes the main combustion chamber (MCC) throat to nozzle attach point, the engine controller. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axis (Q=10) 120 pulses

10 Hz @ 2.8 g peak  
26 Hz @ 11.4 g peak  
100 Hz @ 100 g peak  
380 Hz @ 270 g peak  
620 Hz @ 220 g peak  
800 Hz @ 360 g peak  
1200 Hz @ 480 g peak  
1620 Hz @ 380 g peak  
2000 Hz @ 340 g peak

Parallel to the engine centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 280 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
280 - 350 Hz @ +32.35 dB/oct  
350 - 850 Hz @  $0.22 (g \text{ rms})^2/\text{Hz}$   
850 - 880 Hz @ +47.43 dB/oct  
880 - 910 Hz @  $0.38 (g \text{ rms})^2/\text{Hz}$   
910 - 930 Hz @ -52.55 dB/oct  
930 - 1060 Hz @  $0.26 (g \text{ rms})^2/\text{Hz}$   
1060 - 1100 Hz @ +16.87 dB/oct  
1100 - 1600 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
1600 - 1680 Hz @ +57.3 dB/oct  
1680 - 1840 Hz @  $0.81 (g \text{ rms})^2/\text{Hz}$   
1840 - 1870 Hz @ -43.85 dB/oct  
1870 - 2000 Hz @  $0.64 (g \text{ rms})^2/\text{Hz}$

(Zone B)

Random composite reference level = 25.10 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 5.8 g rms at 500 Hz, 4.7 g rms at 600 Hz and 4.0 g rms at 2000 Hz for 6.5 hr and 5.1 g rms at 1200 Hz for 7.5 hr.

Sinusoidal sweeps of 5.8 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 4.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 27.64 g rms

Radial to engine centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 -	150 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
150 -	260 Hz @ +7.16 dB/oct
260 -	350 Hz @ 0.037 (g rms) <sup>2</sup> /Hz
350 -	400 Hz @ +43.07 dB/oct
400 -	700 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
700 -	830 Hz @ +13.61 dB/oct
830 -	860 Hz @ 0.54 (g rms) <sup>2</sup> /Hz
860 -	890 Hz @ -38.07 dB/oct
890 -	920 Hz @ 0.35 (g rms) <sup>2</sup> /Hz
920 -	930 Hz @ -93.69 dB/oct
930 -	1080 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
1080 -	1140 Hz @ +44.90 dB/oct
1140 -	1250 Hz @ 0.56 (g rms) <sup>2</sup> /Hz
1250 -	1280 Hz @ -30.61 dB/oct
1280 -	1660 Hz @ 0.44 (g rms) <sup>2</sup> /Hz
1660 -	1800 Hz @ +52.38 dB/oct
1800 -	2000 Hz @ 1.8 (g rms) <sup>2</sup> /Hz

(Zone B)

Random composite reference level = 31.32 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 8.0 g rms at 500 Hz, 3.8 g rms at 600 Hz and 5.5 g rms at 2000 Hz for 6.5 hr and 1.9 g rms at 1000 Hz for 7.5 hr.

Sinusoidal sweeps of 8.0 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 5.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 33.06 g rms.

(Zone B-1)

#### 4.5.2.1 SSME Vibration Criteria Zone B-1

This zone includes the flight accelerometer safety cutoff system (FASCOS). Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

X, Y and Z axes (Q=10) 120 pulses

20 Hz @ 20.0 g peak  
70 Hz @ 90.0 g peak  
800 Hz @ 80.0 g peak  
2000 Hz @ 250 g peak

Longitudinal direction (component X axis)

Steady state random vibration amplitudes-R4:

20 - 380 Hz @  $0.002 (g \text{ rms})^2/\text{Hz}$   
380 - 450 Hz @ +42.70 dB/oct  
450 - 600 Hz @  $0.022 (g \text{ rms})^2/\text{Hz}$   
600 - 680 Hz @ -46.37 dB/oct  
680 - 1100 Hz @  $0.0032 (g \text{ rms})^2/\text{Hz}$   
1100 - 1250 Hz @ +26.83 dB/oct  
1250 - 1400 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
1400 - 1500 Hz @ -15.56 dB/oct  
1500 - 2000 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 3.67 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 2.5 g rms at 1000 Hz for 7.5 hr.

Total composite level = 4.44 g rms

(Zone B-1)

Tangential direction (component Y axis)

Steady state random vibration amplitudes-R4:

20 - 380 Hz @  $0.002 (g \text{ rms})^2/\text{Hz}$   
380 - 450 Hz @ +42.69 dB/oct  
450 - 600 Hz @  $0.022 (g \text{ rms})^2/\text{Hz}$   
600 - 610 Hz @ -58.00 dB/oct  
610 - 680 Hz @  $0.016 (g \text{ rms})^2/\text{Hz}$   
680 - 750 Hz @ -11.51 dB/oct  
750 - 920 Hz @  $0.011 (g \text{ rms})^2/\text{Hz}$   
920 - 1000 Hz @ -10.17 dB/oct  
1000 - 1060 Hz @  $0.0083 (g \text{ rms})^2/\text{Hz}$   
1060 - 1090 Hz @ -46.37 dB/oct  
1090 - 1170 Hz @  $0.0054 (g \text{ rms})^2/\text{Hz}$   
1170 - 1200 Hz @ +104.46 dB/oct  
1200 - 1250 Hz @  $0.013 (g \text{ rms})^2/\text{Hz}$   
1250 - 1280 Hz @ -33.30 dB/oct  
1280 - 1400 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
1400 - 1500 Hz @ -15.56 dB/oct  
1500 - 2000 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 4.17 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.67 g rms at 500 Hz, 0.69 g rms at 600 Hz and 0.32 g rms at 2000 Hz for 6.5 hr and 0.42 g rms at 1000 Hz for 7.5 hr

Sinusoidal sweeps of 0.69 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 0.32 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 4.31 g rms



(Zone B-1)

Vertical direction (component Z axis)

Steady state random vibration amplitudes-R4:

20 - 380 Hz @ 0.002 (g rms)<sup>2</sup>/Hz  
380 - 450 Hz @ +42.69 dB/oct  
450 - 600 Hz @ 0.022 (g rms)<sup>2</sup>/Hz  
600 - 680 Hz @ -46.37 dB/oct  
680 - 1100 Hz @ 0.0032 (g rms)<sup>2</sup>/Hz  
1100 - 1250 Hz @ +26.83 dB/oct  
1250 - 1620 Hz @ 0.01 (g rms)<sup>2</sup>/Hz  
1620 - 1670 Hz @ -35.32 dB/oct  
1670 - 2000 Hz @ 0.007 (g rms)<sup>2</sup>/Hz

Random composite reference level = 3.75 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.49 g rms at 500 Hz for 6.5 hr and 0.27 g rms at 1000 Hz for 7.5 hr.

Sinusoidal sweep of 0.49 g rms from 350 Hz to 500 Hz to 350 Hz at 150 Hz/min for 1.0 hr.

Total composite level - 3.79 g rms

#### 4.5.3 SSME Vibration Criteria Zone C

This zone includes the thrust chamber nozzle and the engine attach point for the heat shield. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 5.0 g peak  
 25 Hz @ 120 g peak  
 150 Hz @ 640 g peak  
 260 Hz @ 5740 g peak  
 850 Hz @ 5740 g peak  
 1100 Hz @ 7570 g peak  
 1520 Hz @ 5740 g peak  
 1670 Hz @ 6500 g peak  
 2000 Hz @ 4340 g peak

Parallel to the engine centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 230 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
 230 - 350 Hz @ +24.39 dB/oct  
 350 - 640 Hz @  $3.0 (g \text{ rms})^2/\text{Hz}$   
 640 - 660 Hz @ +43.92 dB/oct  
 660 - 700 Hz @  $4.7 (g \text{ rms})^2/\text{Hz}$   
 700 - 720 Hz @ -47.97 dB/oct  
 720 - 850 Hz @  $3.0 (g \text{ rms})^2/\text{Hz}$   
 850 - 1260 Hz @ +8.32 dB/oct  
 1260 - 1450 Hz @  $8.9 (g \text{ rms})^2/\text{Hz}$   
 1450 - 1800 Hz @ -29.22 dB/oct  
 1800 - 2000 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level - 84.90 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 30 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 30 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min for 1.0 hr.

Total composite level = 90.04 g rms

(Zone C)

Radial to the engine centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20	-	150 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
150	-	170 Hz @ +38.71 dB/oct
170	-	200 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
200	-	220 Hz @ -30.98 dB/oct
220	-	230 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
230	-	250 Hz @ +89.71 dB/oct
250	-	260 Hz @ 1.8 (g rms) <sup>2</sup> /Hz
260	-	270 Hz @ -110.58 dB/oct
270	-	310 Hz @ 0.45 (g rms) <sup>2</sup> /Hz
310	-	330 Hz @ +92.92 dB/oct
330	-	350 Hz @ 3.1 (g rms) <sup>2</sup> /Hz
350	-	360 Hz @ -41.62 dB/oct
360	-	750 Hz @ 2.1 (g rms) <sup>2</sup> /Hz
750	-	870 Hz @ -13.12 dB/oct
870	-	960 Hz @ 1.1 (g rms) <sup>2</sup> /Hz
960	-	1010 Hz @ +76.54 dB/oct
1010	-	1240 Hz @ 4.0 (g rms) <sup>2</sup> /Hz
1240	-	1800 Hz @ -10.43 dB/oct
1800	-	2000 Hz @ 1.1 (g rms) <sup>2</sup> /Hz

Random composite reference level = 61.42 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 9.8 g rms at 500 Hz and 35 g rms at 600 Hz for 6.5 hr

Sinusoidal sweep of 35 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr.

Total composite level = 71.37 g rms

#### 4.5.4 SSME Vibration Criteria Zone D

This zone includes the oxidizer preburner (OPB) and the oxidizer preburner igniter. Vibration amplitudes are as follows:

Transient shock spectrum-R2: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 11.5 g peak  
 150 Hz @ 97.0 g peak  
 250 Hz @ 65.0 g peak  
 1400 Hz @ 250 g peak  
 2000 Hz @ 250 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 260 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
 260 - 270 Hz @ +32.34 dB/oct  
 270 - 600 Hz @  $0.015 (g \text{ rms})^2/\text{Hz}$   
 600 - 800 Hz @ +20.85 dB/oct  
 800 - 1070 Hz @  $0.11 (g \text{ rms})^2/\text{Hz}$   
 1070 - 1180 Hz @ +27.62 dB/oct  
 1180 - 1280 Hz @  $0.27 (g \text{ rms})^2/\text{Hz}$   
 1280 - 1310 Hz @ +80.07 dB/oct  
 1310 - 1380 Hz @  $0.5 (g \text{ rms})^2/\text{Hz}$   
 1380 - 1410 Hz @ -86.25 dB/oct  
 1410 - 2000 Hz @  $0.27 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 17.62 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.6 g rms at 500 Hz, 2.6 g rms at 600 Hz, 3.0 g rms at 1000 Hz and 2.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.6 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 2.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.59 g rms

(Zone D)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 - 250 Hz @ 0.006 (g rms)<sup>2</sup>/Hz  
250 - 270 Hz @ +57.36 dB/oct  
270 - 280 Hz @ 0.026 (g rms)<sup>2</sup>/Hz  
280 - 290 Hz @ -47.19 dB/oct  
290 - 480 Hz @ 0.015 (g rms)<sup>2</sup>/Hz  
480 - 760 Hz @ +13.62 dB/oct  
760 - 800 Hz @ 0.12 (g rms)<sup>2</sup>/Hz  
800 - 860 Hz @ -7.59 dB/oct  
860 - 1050 Hz @ 0.1 (g rms)<sup>2</sup>/Hz  
1050 - 1200 Hz @ +22.39 dB/oct  
1200 - 2000 Hz @ 0.27 (g rms)<sup>2</sup>/Hz

Random composite reference level = 17.10 g rms

Superimposed steady-state sinusoid-R4:

Sinusoidal dwells of 3.5 g rms at 500 Hz, 4.6 g rms at 600 Hz, 3.0 g rms at 1000 Hz and 3.4 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.6 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 3.4 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level - 18.61 g rms

(Zone E)

#### 4.5.5 SSME Vibration Criteria Zone E

This zone includes the fuel preburner (FPB) and the fuel preburner igniter. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X,Y and Z axes - start and shutdown - (Q=10) 120 pulses

20 Hz @ 25.0 g peak  
250 Hz @ 150 g peak  
500 Hz @ 130 g peak  
950 Hz @ 300 g peak  
2000 Hz @ 450 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 120 Hz @  $0.012 (g \text{ rms})^2/\text{Hz}$   
120 - 130 Hz @ +10.82 dB/oct  
130 - 180 Hz @  $0.016 (g \text{ rms})^2/\text{Hz}$   
180 - 230 Hz @ +23.68 dB/oct  
230 - 240 Hz @  $0.11 (g \text{ rms})^2/\text{Hz}$   
240 - 260 Hz @ -10.59 dB/oct  
260 - 330 Hz @  $0.083 (g \text{ rms})^2/\text{Hz}$   
330 - 360 Hz @ +15.22 dB/oct  
360 - 710 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
710 - 730 Hz @ -28.43 dB/oct  
730 - 820 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
820 - 900 Hz @ +29.63 dB/oct  
900 - 1040 Hz @  $0.25 (g \text{ rms})^2/\text{Hz}$   
1040 - 1340 Hz @ +6.44 dB/oct  
1340 - 1450 Hz @  $0.43 (g \text{ rms})^2/\text{Hz}$   
1450 - 1600 Hz @ -16.58 dB/oct  
1600 - 1680 Hz @  $0.25 (g \text{ rms})^2/\text{Hz}$   
1680 - 1750 Hz @ +60.78 dB/oct  
1740 - 1830 Hz @  $0.57 (g \text{ rms})^2/\text{Hz}$   
1830 - 2000 Hz @ -21.75 dB/oct  
2000 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 21.98 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.5 g rms at 500 Hz and 8.5 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 8.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1 hr.

Total composite level = 23.70 g rms

(Zone E)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20	-	210 Hz @ 0.012 (g rms) <sup>2</sup> /Hz
210	-	220 Hz @ +52.48 dB/oct
220	-	270 Hz @ 0.027 (g rms) <sup>2</sup> /Hz
270	-	280 Hz @ +14.06 dB/oct
280	-	310 Hz @ 0.032 (g rms) <sup>2</sup> /Hz
310	-	320 Hz @ +21.26 dB/oct
320	-	330 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
330	-	340 Hz @ -22.50 dB/oct
340	-	380 Hz @ 0.032 (g rms) <sup>2</sup> /Hz
380	-	400 Hz @ +23.80 dB/oct
400	-	420 Hz @ 0.048 (g rms) <sup>2</sup> /Hz
420	-	490 Hz @ +2.66 dB/oct
490	-	590 Hz @ 0.055 (g rms) <sup>2</sup> /Hz
590	-	660 Hz @ +26.94 dB/oct
660	-	860 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
860	-	900 Hz @ +33.82 dB/oct
900	-	1170 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
1170	-	1200 Hz @ +49.78 dB/oct
1200	-	1230 Hz @ 0.38 (g rms) <sup>2</sup> /Hz
1230	-	1260 Hz @ -52.31 dB/oct
1260	-	1310 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
1310	-	1530 Hz @ +17.92 dB/oct
1530	-	1640 Hz @ 0.63 (g rms) <sup>2</sup> /Hz
1640	-	2000 Hz @ -8.07 dB/oct
		2000 Hz @ 0.37 (g rms) <sup>2</sup> /Hz

Random composite reference level = 22.54 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.5 g rms at 500 Hz and 8.5 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 8.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr.

Total composite level = 24.22 g rms

(Zone F)

#### 4.5.6 SSME Vibration Criteria Zone F

This zone includes the low-pressure oxidizer turbopump (LPOTP). Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 2.0 g peak  
60 Hz @ 40.0 g peak  
100 Hz @ 120 g peak  
125 Hz @ 30.0 g peak  
200 Hz @ 50.0 g peak  
1000 Hz @ 90.0 g peak  
1440 Hz @ 100 g peak  
2000 Hz @ 170 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 180 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
180 - 200 Hz @ +31.39 dB/oct  
200 - 320 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
320 - 360 Hz @ +42.87 dB/oct  
360 - 440 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
440 - 480 Hz @ -23.98 dB/oct  
480 - 680 Hz @  $0.16 (g \text{ rms})^2/\text{Hz}$   
680 - 700 Hz @ +75.18 dB/oct  
700 - 720 Hz @  $0.33 (g \text{ rms})^2/\text{Hz}$   
720 - 740 Hz @ -79.54 dB/oct  
740 - 1030 Hz @  $0.16 (g \text{ rms})^2/\text{Hz}$   
1030 - 1050 Hz @ +171.97 dB/oct  
1050 - 1080 Hz @  $0.48 (g \text{ rms})^2/\text{Hz}$   
1080 - 1100 Hz @ -152.04 dB/oct  
1100 - 1130 Hz @  $0.19 (g \text{ rms})^2/\text{Hz}$   
1130 - 1700 Hz @ +16.15 dB/oct  
1700 - 2000 Hz @  $1.7 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 33.30 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 10 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweep of 10 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 34.77 g rms



(Zone F)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 - 210 Hz @  $0.013 (g \text{ rms})^2/\text{Hz}$   
210 - 220 Hz @ +17.36 dB/oct  
220 - 250 Hz @  $0.017 (g \text{ rms})^2/\text{Hz}$   
250 - 260 Hz @ +35.51 dB/oct  
260 - 330 Hz @  $0.027 (g \text{ rms})^2/\text{Hz}$   
330 - 360 Hz @ +70.97 dB/oct  
360 - 460 Hz @  $0.21 (g \text{ rms})^2/\text{Hz}$   
460 - 510 Hz @ -64.52 dB/oct  
510 - 560 Hz @  $0.023 (g \text{ rms})^2/\text{Hz}$   
560 - 600 Hz @ +41.84 dB/oct  
600 - 680 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
680 - 690 Hz @ +142.93 dB/oct  
690 - 710 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
710 - 720 Hz @ -149.19 dB/oct  
720 - 1230 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
1230 - 1270 Hz @ +86.19 dB/oct  
1270 - 1340 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1340 - 1370 Hz @ -124.58 dB/oct  
1370 - 1500 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
1500 - 1650 Hz @ +63.64 dB/oct  
1650 - 2000 Hz @  $0.45 (g \text{ rms})^2/\text{Hz}$

Random composite reference level - 16.96 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 2.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweep of 2.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 17.14 g rms

#### 4.5.6.1 SSME Vibration Criteria Zone F-1

This zone includes the low pressure oxidizer turbopump (LPOTP) low net positive suction pressure (NPSP) and 24 NPSP. Vibration amplitudes are as follows:

##### Parallel to pump centerline (engine X axis)

##### Steady-state random vibration amplitudes-R4:

20	-	180 Hz	@	0.02 (g rms) <sup>2</sup> /Hz
180	-	200 Hz	@	+31.39 dB/oct
200	-	320 Hz	@	0.06 (g rms) <sup>2</sup> /Hz
320	-	360 Hz	@	+42.78 dB/oct
360	-	440 Hz	@	0.32 (g rms) <sup>2</sup> /Hz
440	-	480 Hz	@	-23.98 dB/oct
480	-	520 Hz	@	0.16 (g rms) <sup>2</sup> /Hz
520	-	600 Hz	@	+63.67 dB/oct
600	-	640 Hz	@	3.3 (g rms) <sup>2</sup> /Hz
640	-	700 Hz	@	-86.68 dB/oct
700	-	880 Hz	@	0.25 (g rms) <sup>2</sup> /Hz
880	-	990 Hz	@	-23.62 dB/oct
990	-	1040 Hz	@	0.63 (g rms) <sup>2</sup> /Hz
1040	-	1090 Hz	@	-45.46 dB/oct
1090	-	1170 Hz	@	0.31 (g rms) <sup>2</sup> /Hz
1170	-	1700 Hz	@	+22.40 dB/oct
1700	-	2000 Hz	@	5.0 (g rms) <sup>2</sup> /Hz

Total composite level = 54.58 g rms

(Zone F-1)

Radial to pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 - 150 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$   
150 - 190 Hz @ +22.2 dB/oct  
190 - 210 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
210 - 220 Hz @ -55.37 dB/oct  
220 - 320 Hz @  $0.017 (g \text{ rms})^2/\text{Hz}$   
320 - 360 Hz @ +64.25 dB/oct  
360 - 460 Hz @  $0.21 (g \text{ rms})^2/\text{Hz}$   
460 - 510 Hz @ -64.52 dB/oct  
510 - 560 Hz @  $0.023 (g \text{ rms})^2/\text{Hz}$   
560 - 600 Hz @ +68.28 dB/oct  
600 - 630 Hz @  $0.11 (g \text{ rms})^2/\text{Hz}$   
630 - 650 Hz @ -58.38 dB/oct  
650 - 700 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
700 - 720 Hz @ +90.54 dB/oct  
720 - 740 Hz @  $0.14 (g \text{ rms})^2/\text{Hz}$   
740 - 770 Hz @ -64.18 dB/oct  
770 - 960 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
960 - 980 Hz @ +133.77 dB/oct  
980 - 1020 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1020 - 1090 Hz @ -41.56 dB/oct  
1090 - 1150 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
1150 - 1200 Hz @ +36.13 dB/oct  
1200 - 1390 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
1390 - 1650 Hz @ +26.41 dB/oct  
1650 - 2000 Hz @  $0.45 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 17.99 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 0.5 g rms at 270 Hz for 7.5 hr.

Total composite level = 18.0 g rms

#### 4.5.6.2 SSME Vibration Criteria Zone F-2

This zone includes the low pressure oxidizer turbopump (LPO TP) discharge duct flex joint. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X axis (Q=10) 120 pulses

15 Hz @ 50.0 g peak  
25 Hz @ 100 g peak  
150 Hz @ 100 g peak  
300 Hz @ 500 g peak  
600 Hz @ 220 g peak  
2000 Hz @ 800 g peak

##### Y axis (Q=10) 120 pulses

15 Hz @ 40.0 g peak  
25 Hz @ 100 g peak  
110 Hz @ 65.0 g peak  
150 Hz @ 110 g peak  
350 Hz @ 110 g peak  
2000 Hz @ 700 g peak

##### Z axis (Q=10) 120 pulses

15 Hz @ 18.0 g peak  
25 Hz @ 80.0 g peak  
220 Hz @ 90.0 g peak  
320 Hz @ 130 g peak  
1500 Hz @ 400 g peak  
2000 Hz @ 400 g peak

(Zone F-2)

Perpendicular to flow direction (component X axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine RPL operation time)

20	-	170 Hz @ 0.019 (g rms) <sup>2</sup> /Hz
170	-	200 Hz @ +26.40 dB/oct
200	-	318 Hz @ 0.079 (g rms) <sup>2</sup> /Hz
318	-	356 Hz @ +32.77 dB/oct
		356 Hz @ 0.270 (g rms) <sup>2</sup> /Hz
356	-	383 Hz @ -52.20 dB/oct
383	-	670 Hz @ 0.076 (g rms) <sup>2</sup> /Hz
670	-	710 Hz @ +112.21 dB/oct
710	-	1500 Hz @ 0.66 (g rms) <sup>2</sup> /Hz
1500	-	1555 Hz @ +68.63 dB/oct
1555	-	1877 Hz @ 1.50 (g rms) <sup>2</sup> /Hz
1877	-	1884 Hz @ -775.42 dB/oct
1884	-	1945 Hz @ 0.575 (g rms) <sup>2</sup> /Hz
1945	-	1965 Hz @ +257.61 dB/oct
1965	-	2000 Hz @ 1.38 (g rms) <sup>2</sup> /Hz

Random composite reference level = 35.01 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.5 g rms at 470 Hz, 3.5 g rms at 575 Hz and 15.5 g rms at 1900 Hz for 6.5 hr.

Sinusoidal sweeps of 3.5 g rms from 350 Hz to 600 Hz to 350 Hz at 250 Hz/min and 15.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz/min for 1.0 hr.

Total composite level = 42.34 g rms

(Zone F-2)

Perpendicular to flow direction (component X axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine FPL operation time)

20 - 170 Hz @  $0.019 (g \text{ rms})^2/\text{Hz}$   
170 - 200 Hz @ +26.40 dB/oct  
200 - 318 Hz @  $0.079 (g \text{ rms})^2/\text{Hz}$   
318 - 356 Hz @ +32.77 dB/oct  
356 - 383 Hz @  $0.270 (g \text{ rms})^2/\text{Hz}$   
383 - 670 Hz @ -52.20 dB/oct  
670 - 710 Hz @  $0.076 (g \text{ rms})^2/\text{Hz}$   
710 - 710 Hz @ +112.21 dB/oct  
710 - 1515 Hz @  $0.66 (g \text{ rms})^2/\text{Hz}$   
1515 - 1620 Hz @ +78.04 dB/oct  
1620 - 1620 Hz @  $3.75 (g \text{ rms})^2/\text{Hz}$   
1620 - 1645 Hz @ -137.83 dB/Hz  
1645 - 1645 Hz @  $1.860 (g \text{ rms})^2/\text{Hz}$   
1645 - 1770 Hz @ +1.09 dB/oct  
1770 - 1770 Hz @  $1.910 (g \text{ rms})^2/\text{Hz}$   
1770 - 1790 Hz @ +162.26 dB/oct  
1790 - 2000 Hz @  $3.5 (g \text{ rms})^2/\text{Hz}$

Random composite level - 43.20 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.9 g rms at 500 Hz, 4.0 g rms at 600 Hz, 6.3 g rms at 1500 Hz and 22.0 g rms at 2000 Hz for 3.9 hr.

Total composite level = 48.94 g rms

Parallel to flow direction (component Y axis)

## Steady-state random vibration amplitudes-R4:

20	-	180 Hz @ 0.028 (g rms) <sup>2</sup> /Hz
180	-	200 Hz @ +28.15 dB/oct
200	-	250 Hz @ 0.075 (g rms) <sup>2</sup> /Hz
250	-	262 Hz @ +48.65 dB/oct
262	-	285 Hz @ 0.160 (g rms) <sup>2</sup> /Hz
285	-	304 Hz @ -64.66 dB/oct
304	-	340 Hz @ 0.040 (g rms) <sup>2</sup> /Hz
340	-	353 Hz @ +184.73 dB/oct
353	-	378 Hz @ 0.400 (g rms) <sup>2</sup> /Hz
378	-	425 Hz @ -35.61 dB/oct
425	-	578 Hz @ 0.100 (g rms) <sup>2</sup> /Hz
578	-	588 Hz @ +336.41 dB/oct
588	-	617 Hz @ 0.680 (g rms) <sup>2</sup> /Hz
617	-	660 Hz @ -33.68 dB/oct
660	-	682 Hz @ 0.320 (g rms) <sup>2</sup> /Hz
682	-	705 Hz @ +87.59 dB/oct
705	-	730 Hz @ 0.840 (g rms) <sup>2</sup> /Hz
730	-	755 Hz @ -132.88 dB/oct
755	-	810 Hz @ 0.190 (g rms) <sup>2</sup> /Hz
810	-	930 Hz @ +26.80 dB/oct
930	-	1140 Hz @ 0.650 (g rms) <sup>2</sup> /Hz
1140	-	1260 Hz @ -29.97 dB/oct
1260	-	1300 Hz @ 0.240 (g rms) <sup>2</sup> /Hz
1300	-	1380 Hz @ +56.76 dB/oct
1380	-	1560 Hz @ 0.740 (g rms) <sup>2</sup> /Hz
1560	-	1610 Hz @ +58.07 dB/oct
1610	-	1815 Hz @ 1.360 (g rms) <sup>2</sup> /Hz
1815	-	1845 Hz @ -86.30 dB/oct
1845	-	2000 Hz @ 0.85 (g rms) <sup>2</sup> /Hz

Random composite reference level = 30.52 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 6.3 g rms at 500 Hz, 6.3 g rms at 1000 Hz, 5.7 g rms at 1500 Hz and 27.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 6.3 g rms from 350 Hz to 600 Hz to 350 Hz at 250 Hz/min and 27.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 43.53 g rms

Parallel to engine thrust line (component Z axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine RPL operation time)

20	-	230 Hz @ 0.030 (g rms) <sup>2</sup> /Hz
230	-	330 Hz @ +7.07 dB/oct
330	-	760 Hz @ 0.070 (g rms) <sup>2</sup> /Hz
760	-	835 Hz @ +17.24 dB/oct
835	-	1150 Hz @ 0.120 (g rms) <sup>2</sup> /Hz
1150	-	1175 Hz @ +113.51 dB/oct
		1175 Hz @ 0.27 (g rms) <sup>2</sup> /Hz
1175	-	1225 Hz @ -64.68 dB/oct
1225	-	1260 Hz @ 0.110 (g rms) <sup>2</sup> /Hz
1260	-	1325 Hz @ +107.23 dB/oct
1325	-	1370 Hz @ 0.660 (g rms) <sup>2</sup> /Hz
1370	-	1390 Hz @ -354.09 dB/oct
1390	-	1420 Hz @ 0.120 (g rms) <sup>2</sup> /Hz
1420	-	1435 Hz @ +232.31 dB/oct
1435	-	1550 Hz @ 0.270 (g rms) <sup>2</sup> /Hz
1550	-	1600 Hz @ +115.20 dB/oct
1600	-	1850 Hz @ 0.910 (g rms) <sup>2</sup> /Hz
1850	-	1880 Hz @ -97.66 dB/oct
1880	-	2000 Hz @ 0.540 (g rms) <sup>2</sup> /Hz

Random composite reference level = 23.17 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.9 g rms at 470 Hz, 4.5 g rms at 575 Hz and 20.0 g rms at 1800 Hz for 2.6 hr.

Sinusoidal sweeps of 4.9 g rms from 350 Hz to 600 Hz to 350 Hz at 250 Hz/min and 20.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 32.26 g rms.



(Zone F-2)

Parallel to engine thrust line (component Z axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine FPL operation time)

20 -	86 Hz @ 0.014 Hz (g rms) <sup>2</sup> /Hz
86 -	110 Hz @ +3.73 dB/oct
110 -	136 Hz @ 0.019 (g rms) <sup>2</sup> /Hz
136 -	146 Hz @ -23.19 dB/oct
146 -	180 Hz @ 0.011 (g rms) <sup>2</sup> /Hz
180 -	193 Hz @ +40.33 dB/oct
193 -	216 Hz @ 0.028 (g rms) <sup>2</sup> /Hz
216 -	334 Hz @ +3.58 dB/oct
334 -	400 Hz @ 0.047 (g rms) <sup>2</sup> /Hz
400 -	505 Hz @ -8.15 dB/oct
505 -	548 Hz @ 0.025 (g rms) <sup>2</sup> /Hz
548 -	579 Hz @ +61.54 dB/oct
579 -	681 Hz @ 0.077 (g rms) <sup>2</sup> /Hz
681 -	745 Hz @ +14.87 dB/oct
745 -	995 Hz @ 0.120 (g rms) <sup>2</sup> /Hz
895 -	930 Hz @ +57.60 dB/oct
930 -	1180 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
1180 -	1555 Hz @ +16.06 dB/oct
1555 -	2000 Hz @ 1.09 (g rms) <sup>2</sup> /Hz

Random composite reference level = 28.70 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.0 g rms at 500 Hz, 2.2 g rms at 600 Hz, 1.8 g rms at 720 Hz and 27.0 g rms at 2000 Hz for 3.9 hr.

Total composite level = 36.23 g rms

**4.5.7 SSME Vibration Criteria Zone G**

This zone includes the high-pressure oxidizer turbopump (HPOTP) and the high-pressure oxidizer turbopump boost pump. Vibration amplitudes are as follows:

**Transient shock spectrum-R4: (engine axes)**

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 2.0 g peak  
30 Hz @ 28.0 g peak  
60 Hz @ 53.0 g peak  
220 Hz @ 104 g peak  
320 Hz @ 200 g peak  
950 Hz @ 157 g peak  
2000 Hz @ 333 g peak

Parallel to the pump centerline (engine X axis)

**Steady state random vibration amplitudes-R4:**

20 - 150 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
150 - 230 Hz @ +8.08 dB/oct  
230 - 340 Hz @  $0.063 (g \text{ rms})^2/\text{Hz}$   
340 - 380 Hz @ +19.61 dB/oct  
380 - 400 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
400 - 430 Hz @ -10.92 dB/oct  
430 - 590 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
590 - 650 Hz @ -6.94 dB/oct  
650 - 790 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
790 - 900 Hz @ +18.73 dB/oct  
900 - 1100 Hz @  $0.18 (g \text{ rms})^2/\text{Hz}$   
1100 - 1250 Hz @ +15.66 dB/oct  
1250 - 1580 Hz @  $0.35 (g \text{ rms})^2/\text{Hz}$   
1580 - 1690 Hz @ +51.22 dB/oct  
1690 - 2000 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$

(Zone G)

Random composite reference level = 25.93 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.9 g rms at 500 Hz, 2.0 g rms at 600 Hz, 2.8 g rms at 1000 Hz and 8.7 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.9 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min, 2.8 g rms from 700 Hz to 1040 Hz to 700 Hz at 340 Hz/minute and 8.7 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/minute for 1.8 hr.

Total composite level = 28.0 g rms

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 -	150 Hz @	$0.02 (g \text{ rms})^2/\text{Hz}$
150 -	220 Hz @	+7.20 dB/oct
220 -	250 Hz @	$0.05 (g \text{ rms})^2/\text{Hz}$
250 -	280 Hz @	-5.93 dB/oct
280 -	750 Hz @	$0.04 (g \text{ rms})^2/\text{Hz}$
750 -	900 Hz @	+21.82 dB/oct
900 -	1260 Hz @	$0.15 (g \text{ rms})^2/\text{Hz}$
1260 -	1440 Hz @	+15.63 dB/oct
1440 -	2000 Hz @	$0.3 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 17.34 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 7.3 g rms at 500 Hz, 2.7 g rms at 600 Hz, 4.4 g rms at 1000 Hz and 9.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 7.3 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min, 4.4 g rms from 700 Hz to 1040 Hz to 700 Hz at 340 Hz/min and 9.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 21.48 g rms.

#### 4.5.7.1 SSME Vibration Criteria Zone G-1

This zone includes the heat exchanger. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X and Y axes (Q=10) 120 pulses

10 Hz @ 10.0 g peak  
150 Hz @ 25.0 g peak  
350 Hz @ 25.0 g peak  
900 Hz @ 90.0 g peak  
2000 Hz @ 210 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 10.0 g peak  
20 Hz @ 25.0 g peak  
200 Hz @ 25.0 g peak  
350 Hz @ 55.0 g peak  
650 Hz @ 55.0 g peak  
2000 Hz @ 170 g peak

##### Radial to the pump centerline (component X and Y axes)

Steady-state random vibration amplitudes-R4:

20 - 410 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
410 - 420 Hz @ +26.20 dB/oct  
420 - 790 Hz @  $0.037 (g \text{ rms})^2/\text{Hz}$   
790 - 930 Hz @ +43.46 dB/oct  
930 - 1180 Hz @  $0.39 (g \text{ rms})^2/\text{Hz}$   
1180 - 1450 Hz @ -31.23 dB/oct  
1450 - 1740 Hz @  $0.046 (g \text{ rms})^2/\text{Hz}$   
1740 - 1870 Hz @ +17.54 dB/oct  
1870 - 2000 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 14.72 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.7 g rms at 500 Hz, 3.5 g rms at 600 Hz, 3.4 g rms at 1000 Hz at 10.6 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.7 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 10.6 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 19.15 g rms

Parallel to the pump centerline (component Z axis)

Steady-state random vibration amplitudes-R4:

20 -	260 Hz @	$0.01 (g \text{ rms})^2/\text{Hz}$
260 -	270 Hz @	$+32.34 \text{ dB/oct}$
270 -	600 Hz @	$0.015 (g \text{ rms})^2/\text{Hz}$
600 -	800 Hz @	$+20.85 \text{ dB/oct}$
800 -	1070 Hz @	$0.11 (g \text{ rms})^2/\text{Hz}$
1070 -	1180 Hz @	$+27.62 \text{ dB/oct}$
1180 -	1280 Hz @	$0.27 (g \text{ rms})^2/\text{Hz}$
1280 -	1310 Hz @	$+80.07 \text{ dB/oct}$
1310 -	1380 Hz @	$0.5 (g \text{ rms})^2/\text{Hz}$
1380 -	1410 Hz @	$-86.25 \text{ dB/oct}$
1410 -	2000 Hz @	$0.27 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 17.62 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.6 g rms at 500 Hz, 2.6 g rms at 600 Hz, 3.3 g rms at 1000 Hz and 2.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.6 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 3.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.64 g rms

(Zone G-2)

#### 4.5.7.2 SSME Vibration Criteria Zone G-2

This zone includes the oxidizer tank pressurant duct flex joint. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
25 Hz @ 13.5 g peak  
60 Hz @ 21.0 g peak  
125 Hz @ 15.5 g peak  
250 Hz @ 69.0 g peak  
460 Hz @ 110 g peak  
1260 Hz @ 94.0 g peak  
2000 Hz @ 52.0 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 1.6 g peak  
25 Hz @ 21.0 g peak  
80 Hz @ 11.0 g peak  
160 Hz @ 32.0 g peak  
250 Hz @ 41.0 g peak  
500 Hz @ 32.0 g peak  
800 Hz @ 63.0 g peak  
2000 Hz @ 48.0 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 3.0 g peak  
25 Hz @ 9.6 g peak  
60 Hz @ 8.4 g peak  
120 Hz @ 27.0 g peak  
310 Hz @ 59.0 g peak  
770 Hz @ 63.0 g peak  
1260 Hz @ 68.0 g peak  
2000 Hz @ 51.0 g peak

Perpendicular to flow direction (component X axis)

Steady-state random vibration amplitudes-R4:

20 - 80 Hz @  $0.024 (g \text{ rms})^2/\text{Hz}$   
80 - 135 Hz @ +6.93 dB/oct  
135 - 280 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
280 - 400 Hz @ +28.71 dB/oct  
400 - 600 Hz @  $2.4 (g \text{ rms})^2/\text{Hz}$   
600 - 740 Hz @ -50.74 dB/oct  
740 - 1120 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
1120 - 1150 Hz @ +70.50 dB/oct  
1150 - 1210 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
1210 - 1250 Hz @ -57.30 dB/oct  
1250 - 1280 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
1280 - 1310 Hz @ +99.03 dB/oct  
1310 - 1320 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1320 - 1360 Hz @ -76.85 dB/oct  
1360 - 1500 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
1500 - 2000 Hz @ -5.10 dB/oct  
2000 Hz @  $0.043 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 27.58 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 6.0 g rms at 270 Hz for 6.5 hr.

Sinusoidal sweep of 6.0 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min for 1.0 hr.

Total composite level = 28.22 g rms.

Parallel to engine centerline (component Y axis)

Steady-state random vibration amplitudes-R4:

20	-	60 Hz @ 0.018 (g rms) <sup>2</sup> /Hz
60	-	160 Hz @ -1.80 dB/oct
160	-	340 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
340	-	400 Hz @ +42.65 dB/oct
400	-	700 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
700	-	1100 Hz @ -6.80 dB/oct
1100	-	1480 Hz @ 0.036 (g rms) <sup>2</sup> /Hz
1480	-	1550 Hz @ +72.76 dB/oct
1550	-	1590 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
1590	-	1670 Hz @ -68.49 dB/oct
1670	-	1810 Hz @ 0.036 (g rms) <sup>2</sup> /Hz
1810	-	1880 Hz @ +46.88 dB/oct
1880	-	1890 Hz @ 0.065 (g rms) <sup>2</sup> /Hz
1890	-	1930 Hz @ -84.93 dB/oct
1930	-	2000 Hz @ 0.036 (g rms) <sup>2</sup> /Hz

Random composite reference level = 10.10 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.8 g rms at 270 Hz and 1.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 0.8 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min and 1.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 10.24 g rms



(Zone G-2)

Parallel to flow direction (component Z axis)

Steady-state random vibration amplitudes-R4:

20 - 80 Hz @  $0.024 (g \text{ rms})^2/\text{Hz}$   
80 - 135 Hz @ +6.93 dB/oct  
135 - 280 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
280 - 400 Hz @ +28.7 dB/oct  
400 - 600 Hz @  $2.4 (g \text{ rms})^2/\text{Hz}$   
600 - 740 Hz @ -50.74 dB/oct  
740 - 1440 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
1440 - 1500 Hz @ +39.75 dB/oct  
1500 - 1560 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
1560 - 1760 Hz @ -17.30 dB/oct  
1760 - 2000 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 27.67 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal sweep of 1.9 g rms at 2000 Hz for 6.5 hr.

Sinusoidal dwell of 1.9 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 27.74 g rms



4.5.8 SSME Vibration Criteria Zone H

This zone includes the low-pressure fuel turbopump (LPFTP). Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 5.0 g peak  
 60 Hz @ 40.0 g peak  
 510 Hz @ 40.0 g peak  
 800 Hz @ 60.0 g peak  
 2000 Hz @ 380 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 180 Hz @  $0.005 (g \text{ rms})^2/\text{Hz}$   
 180 - 200 Hz @ +31.38 dB/oct  
 200 - 220 Hz @  $0.015 (g \text{ rms})^2/\text{Hz}$   
 220 - 250 Hz @ +19.95 dB/oct  
 250 - 290 Hz @  $0.035 (g \text{ rms})^2/\text{Hz}$   
 290 - 300 Hz @ -29.88 dB/oct  
 300 - 320 Hz @  $0.025 (g \text{ rms})^2/\text{Hz}$   
 320 - 330 Hz @ 63.81 dB/oct  
 330 - 340 Hz @  $0.048 (g \text{ rms})^2/\text{Hz}$   
 340 - 350 Hz @ -81.02 dB/oct  
 350 - 360 Hz @  $0.022 (g \text{ rms})^2/\text{Hz}$   
 360 - 370 Hz @ +51.01 dB/oct  
 370 - 390 Hz @  $0.035 (g \text{ rms})^2/\text{Hz}$   
 390 - 400 Hz @ -55.21 dB/oct  
 400 - 410 Hz @  $0.022 (g \text{ rms})^2/\text{Hz}$   
 410 - 450 Hz @ +71.37 dB/oct  
 450 - 690 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
 690 - 710 Hz @ +42.71 dB/oct  
 710 - 740 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
 740 - 770 Hz @ -43.03 dB/oct  
 770 - 810 Hz @  $0.17 (g \text{ rms})^2/\text{Hz}$   
 810 - 830 Hz @ +57.09 dB/oct  
 830 - 850 Hz @  $0.27 (g \text{ rms})^2/\text{Hz}$   
 850 - 860 Hz @ -77.24 dB/oct  
 860 - 950 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
 950 - 1080 Hz @ -11.99 dB/oct  
 1080 - 1100 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
 1100 - 1130 Hz @ +67.81 dB/oct  
 1130 - 1210 Hz @  $0.22 (g \text{ rms})^2/\text{Hz}$

(Zone H)

1210 - 1260 Hz @ +74.59 dB/oct  
1260 - 1380 Hz @  $0.6 (g \text{ rms})^2/\text{Hz}$   
1380 - 1410 Hz @ 225.28 dB/oct  
1410 - 1440 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
1440 - 1510 Hz @ +184.47 dB/oct  
1510 - 1880 Hz @  $2.2 (g \text{ rms})^2/\text{Hz}$   
1880 - 1970 Hz @ +90.69 dB/oct  
1970 - 2000 Hz @  $9.0 (g \text{ rms})^2/\text{Hz}$

Random compsite reference level = 42.85 g rms

Superimposed steady-state sinusoids-R4.

Sinusoidal dwells of 1.4 g rms at 270 Hz, 1.8 g rms at 540 Hz, 2.5 g rms at 1080 Hz, 4.9 g rms at 1350 Hz and 9.6 g rms at 1620 Hz for 6.5 hr.

Sinusoidal sweeps of 1.4 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, 1.8 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 9.6 g rms from 800 Hz to 1620 Hz to 800 Hz at 420 Hz/min for 1.0 hr

Total composite level = 44.31 g rms

(Zone H)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 -	140 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
140 -	200 Hz @ +22.86 dB/oct
200 -	260 Hz @ 0.075 (g rms) <sup>2</sup> /Hz
260 -	280 Hz @ -60.3 dB/oct
280 -	300 Hz @ 0.017 (g rms) <sup>2</sup> /Hz
300 -	310 Hz @ -48.72 dB/oct
310 -	320 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
320 -	330 Hz @ +51.9 dB/oct
	330 Hz @ 0.017 (g rms) <sup>2</sup> /Hz
330 -	360 Hz @ +17.26 dB/oct
360 -	440 Hz @ 0.028 (g rms) <sup>2</sup> /Hz
440 -	470 Hz @ -15.36 dB/oct
470 -	560 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
560 -	600 Hz @ +17.69 dB/oct
600 -	680 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
680 -	720 Hz @ -29.92 dB/oct
720 -	750 Hz @ 0.017 (g rms) <sup>2</sup> /Hz
750 -	760 Hz @ +129.08 dB/oct
760 -	840 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
840 -	870 Hz @ -53.93 dB/oct
870 -	900 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
900 -	940 Hz @ +86.72 dB/oct
940 -	1090 Hz @ 0.056 (g rms) <sup>2</sup> /Hz
1090 -	1110 Hz @ -103.34 dB/oct
1110 -	1250 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
1250 -	1260 Hz @ +251.86 dB/oct
1260 -	1340 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
1340 -	1360 Hz @ -67.7 dB/oct
1360 -	1450 Hz @ 0.043 (g rms) <sup>2</sup> /Hz
1450 -	1520 Hz @ +43.51 dB/oct
1520 -	1590 Hz @ 0.085 (g rms) <sup>2</sup> /Hz
1590 -	1640 Hz @ +122.61 dB/oct
1640 -	1700 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1700 -	1710 Hz @ +396.83 dB/oct
1710 -	1770 Hz @ 0.65 (g rms) <sup>2</sup> /Hz
1770 -	1790 Hz @ -859.95 dB/oct
1780 -	1870 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
1870 -	1940 Hz @ +129.27 dB/oct
1940 -	2000 Hz @ 0.63 (g rms) <sup>2</sup> /Hz

Random composite reference level = 14.23 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.9 g rms at 270 Hz, 1.4 g rms at 540 Hz, 1.0 g rms at 810 Hz, 4.0 g rms at 1080 Hz, 1.0 g rms at 1350 Hz and 1.3 g rms at 1620 Hz for 6.5 hr.

(Zone H)

Sinusoid sweeps of 1.9 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, 1.4 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 40 g rms from 600 Hz to 1600 Hz to 600 Hz at 420 Hz/min for 1.0 hr

Total composite level = 15.09 g rms



#### 4.5.8.1 SSME Vibration Criteria Zone H-1

This zone includes the low pressure fuel turbopump (LPFTP) inlet flange low net positive suction pressure (4 to 15 NPSP). Vibration amplitudes are as follows:

##### Parallel to the pump centerline (engine X axis)

##### Steady-state random vibration amplitudes-R4:

20	-	100 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
100	-	150 Hz @ -13.31 dB/oct
150	-	200 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
200	-	250 Hz @ +16.51 dB/oct
250	-	410 Hz @ 0.034 (g rms) <sup>2</sup> /Hz
410	-	430 Hz @ -33.54 dB/oct
430	-	520 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
520	-	530 Hz @ +35.26 dB/oct
530	-	600 Hz @ 0.025 (g rms) <sup>2</sup> /Hz
600	-	610 Hz @ +176.80 dB/oct
610	-	630 Hz @ 0.066 (g rms) <sup>2</sup> /Hz
630	-	640 Hz @ -45.57 dB/oct
640	-	670 Hz @ 0.052 (g rms) <sup>2</sup> /Hz
670	-	720 Hz @ +34.98 dB/oct
720	-	760 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
760	-	780 Hz @ -21.13 dB/oct
780	-	800 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
800	-	860 Hz @ +28.85 dB/oct
860	-	990 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
990	-	1050 Hz @ -22.04 dB/oct
1050	-	1100 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
1100	-	1140 Hz @ -22.12 dB/oct
1140	-	1200 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
1200	-	1240 Hz @ +164.49 dB/oct
1240	-	1350 Hz @ 0.6 (g rms) <sup>2</sup> /Hz
1350	-	1380 Hz @ -143.79 dB/oct
1380	-	1440 Hz @ 0.21 (g rms) <sup>2</sup> /Hz
1440	-	1510 Hz @ +154.49 dB/oct
1510	-	1840 Hz @ 2.4 (g rms) <sup>2</sup> /Hz
1840	-	1980 Hz @ +54.71 dB/oct
1980	-	2000 Hz @ 9.1 (g rms) <sup>2</sup> /Hz

Random composite reference level = 44.09 g rms

##### Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.0 g rms at 270 Hz, 1.8 g rms at 540 Hz, 2.5 g rms at 1080 Hz, 4.9 g rms at 1350 Hz and 9.6 g rms at 1620 Hz for 6.5 hr

Sinusoidal sweeps of 1.0 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, 1.8 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 9.6 g rms from 800 Hz to 1620 Hz to 800 Hz at 420 Hz/min for 1.0 hr.

Total composite level = 45.50 g rms

(Zone H-1)

Radial to the pump centerline (engine Y and Xes)

Steady-state random vibration amplitudes-R4:

20 -	80 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
80 -	100 Hz @ -21.72 dB/oct
100 -	200 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
200 -	250 Hz @ +38.61 dB/oct
250 -	300 Hz @ 0.35 (g rms) <sup>2</sup> /Hz
300 -	330 Hz @ -45.84 dB/oct
330 -	370 Hz @ 0.082 (g rms) <sup>2</sup> /Hz
370 -	390 Hz @ -36.92 dB/oct
390 -	530 Hz @ 0.043 (g rms) <sup>2</sup> /Hz
530 -	650 Hz @ +12.44 dB/oct
650 -	700 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
700 -	730 Hz @ +13.07 dB/oct
730 -	750 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
750 -	770 Hz @ -36.79 dB/oct
770 -	820 Hz @ 0.087 (g rms) <sup>2</sup> /Hz
820 -	1140 Hz @ +11.3 dB/oct
1140 -	1310 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1310 -	1370 Hz @ -17.87 dB/oct
1370 -	1460 Hz @ 0.23 (g rms) <sup>2</sup> /Hz
1460 -	1580 Hz @ +62.95 dB/oct
1580 -	1650 Hz @ 1.2 (g rms) <sup>2</sup> /Hz
1650 -	1660 Hz @ +533.29 dB/oct
1660 -	1730 Hz @ 3.5 (g rms) <sup>2</sup> /Hz
1730 -	1760 Hz @ -160.44 dB/oct
1760 -	1870 Hz @ 1.4 (g rms) <sup>2</sup> /Hz
1870 -	1950 Hz @ +94.29 dB/oct
1950 -	2000 Hz @ 5.2 (g rms) <sup>2</sup> /Hz

Random composite reference level = 36.81 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.4 g rms at 540 Hz, 5.9 g rms at 1080 Hz, 4.5 g rms at 1350 Hz and 4.5 g rms at 1620 Hz for 6.5 hr

Sinusoidal sweeps of 1.4 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 5.9 g rms from 800 Hz to 1620 Hz to 800 Hz at 420 Hz/min for 1.0 hr

Total composite level = 37.85 g rms

#### 4.5.8.2 SSME Vibration Criteria Zone H-2

This zone includes the low pressure fuel tur~opump (LPFTP) discharge duct flange.  
Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 4.0 g peak  
190 Hz @ 80.0 g peak  
320 Hz @ 150 g peak  
500 Hz @ 90.0 g peak  
1230 Hz @ 280 g peak  
1630 Hz @ 160 g peak  
2000 Hz @ 210 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 30 Hz @  $0.005 (g \text{ rms})^2/\text{Hz}$   
30 - 70 Hz @ +13.11 dB/oct  
70 - 85 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
85 - 100 Hz @ -35.14 dB/oct  
100 - 200 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
200 - 300 Hz @ +18.45 dB/oct  
300 - 1120 Hz @  $0.36 (g \text{ rms})^2/\text{Hz}$   
1120 - 1300 Hz @ +39.14 dB/oct  
1300 - 1650 Hz @  $2.5 (g \text{ rms})^2/\text{Hz}$   
1650 - 1750 Hz @ -46.88 dB/oct  
1750 - 1850 Hz @  $1.0 (g \text{ rms})^2/\text{Hz}$   
1850 - 2000 Hz @ +26.76 dB/oct  
2000 Hz @  $2.0 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 43.34 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.7 g rms at 540 Hz, 3.3 g rms at 810 Hz, 7.4 g rms at 1350 Hz and 8.3 g rms at 1620 Hz for 6.5 hr.

Sinusoidal sweeps of 3.3 g rms from 400 Hz to 810 Hz to 400 Hz at 210 Hz/min and 8.3 g rms from 1000 Hz to 1620 Hz to 1000 Hz at 420 Hz/min for 1.0 hr.

Total composite level = 44.94 g rms



Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 -	30 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
30 -	70 Hz @ +13.11 dB/oct
70 -	85 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
85 -	100 Hz @ -35.14 dB/oct
100 -	200 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
200 -	300 Hz @ +18.45 dB/oct
300 -	1100 Hz @ 0.36 (g rms) <sup>2</sup> /Hz
1100 -	1140 Hz @ +72.41 dB/oct
1140 -	1190 Hz @ 0.85 (g rms) <sup>2</sup> /Hz
1190 -	1300 Hz @ +36.73 dB/oct
1300 -	1650 Hz @ 2.5 (g rms) <sup>2</sup> /Hz
1650 -	1690 Hz @ -5.13 dB/oct
1690 -	1750 Hz @ 2.4 (g rms) <sup>2</sup> /Hz
1750 -	1780 Hz @ -155.05 dB/oct
1780 -	1850 Hz @ 1.0 (g rms) <sup>2</sup> /Hz
1850 -	2000 Hz @ +26.76 dB/oct
	2000 Hz @ 2.0 (g rms) <sup>2</sup> /Hz

Random composite reference level = 44.72 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.7 g rms at 540 Hz, 3.3 g rms at 810 Hz 3.5 g rms at 1080 Hz, 7.4 g rms at 1350 Hz and 8.3 g rms at 1620 Hz for 6.5 hr

Sinusoidal sweeps of 3.5 g rms from 400 Hz to 1080 Hz to 400 Hz at 280 Hz/min and 8.3 g rms from 1080 Hz to 1620 Hz to 1080 Hz at 420 Hz/min for 1.0 hr

Total composite level = 46.41 g rms

#### 4.5.8.3 SSME Vibration Criteria Zone H-3

This zone includes the low pressure fuel turbopump (LPFTP) turbine flanges.  
Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 4.0 g peak  
32 Hz @ 30.0 g peak  
65 Hz @ 70.0 g peak  
170 Hz @ 50.0 g peak  
480 Hz @ 80.0 g peak  
1000 Hz @ 140 g peak  
2000 Hz @ 100 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 160 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
160 - 210 Hz @ +3.32 dB/oct  
210 - 360 Hz @  $0.027 (g \text{ rms})^2/\text{Hz}$   
360 - 450 Hz @ +27.01 dB/oct  
450 - 700 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
700 - 800 Hz @ +36.28 dB/oct  
800 - 1000 Hz @  $1.0 (g \text{ rms})^2/\text{Hz}$   
1000 - 1300 Hz @ -18.47 dB/oct  
1300 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
1300 - 1460 Hz @ -43.76 dB/oct  
1460 - 1570 Hz @  $0.037 (g \text{ rms})^2/\text{Hz}$   
1570 - 1700 Hz @ +21.90 dB/oct  
1700 - 1860 Hz @  $0.066 (g \text{ rms})^2/\text{Hz}$   
1860 - 2000 Hz @ +17.24 dB/oct  
2000 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 22.50 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.5 g rms at 270 Hz, 5.6 g rms at 540 Hz and 6.0 g rms at 1080 Hz for 6.5 hr.

Sinusoidal sweeps of 4.5 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, 5.6 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 6.0 g rms from 800 Hz to 1080 Hz to 800 Hz at 280 Hz/min for 1.0 hr

Total composite level = 24.42 g rms

(Zone H-3)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20	-	30 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
30	-	70 Hz @ +6.37 dB/oct
70	-	90 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
90	-	130 Hz @ -8.99 dB/oct
130	-	170 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
170	-	250 Hz @ +27.53 dB/oct
250	-	300 Hz @ 0.34 (g rms) <sup>2</sup> /Hz
300	-	330 Hz @ -53.75 dB/oct
330	-	340 Hz @ 0.062 (g rms) <sup>2</sup> /Hz
340	-	350 Hz @ +116.30 dB/oct
350	-	360 Hz @ 0.19 (g rms) <sup>2</sup> /Hz
360	-	370 Hz @ -140.27 dB/oct
370	-	400 Hz @ 0.053 (g rms) <sup>2</sup> /Hz
400	-	420 Hz @ -33.09 dB/oct
420	-	440 Hz @ 0.031 (g rms) <sup>2</sup> /Hz
440	-	450 Hz @ +83.92 dB/oct
450	-	490 Hz @ 0.058 (g rms) <sup>2</sup> /Hz
490	-	550 Hz @ +46.09 dB/oct
550	-	800 Hz @ 0.34 (g rms) <sup>2</sup> /Hz
800	-	1200 Hz @ -14.23 dB/oct
1200	-	1680 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
1680	-	1730 Hz @ +18.71 dB/oct
1730	-	1750 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
1750	-	1780 Hz @ -32.29 dB/oct
1780	-	1840 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
1840	-	1870 Hz @ +92.08 dB/oct
1870	-	1910 Hz @ 0.082 (g rms) <sup>2</sup> /Hz
1910	-	1930 Hz @ -37.58 dB/oct
1930	-	2000 Hz @ 0.072 (g rms) <sup>2</sup> /Hz

Random compsite reference level = 15.46 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.0 g rms at 270 Hz, 2.7 g rms at 540 Hz, and 3.4 g rms at 1080 Hz for 6.5 hr

Sinusoidal sweeps of 3.0 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, 2.7 g rms from 400 Hz to 540 Hz to 400 Hz at 140 Hz/min and 3.4 g rms from 800 Hz to 1080 Hz to 800 Hz at 280 Hz/min for 1.0 hr

Total composite level = 16.33 g rms

(Zone H-4)

#### 4.5.8.4 SSME Vibration Criteria Zone H-4

This zone includes the low pressure fuel turbopump (LPFTP) turbine discharge duct flex joint. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 3.5 g peak  
50 Hz @ 21.3 g peak  
100 Hz @ 27.0 g peak  
250 Hz @ 84.0 g peak  
500 Hz @ 91.0 g peak  
1000 Hz @ 56.0 g peak  
1600 Hz @ 60.0 g peak  
2000 Hz @ 54.0 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 11.5 g peak  
50 Hz @ 21.0 g peak  
100 Hz @ 95.0 g peak  
250 Hz @ 230 g peak  
500 Hz @ 235 g peak  
1200 Hz @ 275 g peak  
1600 Hz @ 98.0 g peak  
2000 Hz @ 300 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 12.0 g peak  
50 Hz @ 14.0 g peak  
100 Hz @ 20.0 g peak  
250 Hz @ 370 g peak  
500 Hz @ 78.0 g peak  
1000 Hz @ 93.0 g peak  
1600 Hz @ 54.0 g peak  
2000 Hz @ 224 g peak

(Zone H-4)

Perpendicular to flow direction (component X axis)

Steady-state random vibration amplitudes-R4:

20 - 100 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
100 - 130 Hz @ +17.26 dB/oct  
130 - 150 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$   
150 - 160 Hz @ -102.49 dB/oct  
160 - 170 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
170 - 180 Hz @ +94.36 dB/oct  
180 - 220 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
220 - 250 Hz @ +62.15 dB/oct  
250 - 260 Hz @  $0.84 (g \text{ rms})^2/\text{Hz}$   
260 - 280 Hz @ -142.8 dB/oct  
280 - 330 Hz @  $0.025 (g \text{ rms})^2/\text{Hz}$   
330 - 370 Hz @ +45.33 dB/oct  
370 - 530 Hz @  $0.14 (g \text{ rms})^2/\text{Hz}$   
530 - 650 Hz @ -22.72 dB/oct  
650 - 710 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
710 - 820 Hz @ +48.12 dB/oct  
820 - 900 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
900 - 1000 Hz @ -26.18 dB/oct  
1000 - 2000 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 15.60 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.0 g rms at 500 Hz, 6.0 g rms at 600 Hz and 2.4 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 6.0 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 2.4 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 17.0 g rms

(Zone H-4)

Parallel to engine thrust line direction (component Y axis)

Steady-state random vibration amplitudes-R4:

20 - 70 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
70 - 130 Hz @ +13.17 dB/oct  
130 - 150 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
150 - 170 Hz @ -9.75 dB/oct  
170 - 210 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
210 - 300 Hz @ -11.21 dB/oct  
300 - 330 Hz @  $0.053 (g \text{ rms})^2/\text{Hz}$   
330 - 360 Hz @ +60.0 dB/oct  
360 - 550 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
550 - 680 Hz @ -28.59 dB/oct  
680 - 730 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
730 - 770 Hz @ +96.20 dB/oct  
770 - 990 Hz @  $0.22 (g \text{ rms})^2/\text{Hz}$   
990 - 1040 Hz @ -61.81 dB/oct  
1040 - 1230 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
1230 - 1420 Hz @ +30.93 dB/oct  
1420 - 1640 Hz @  $0.35 (g \text{ rms})^2/\text{Hz}$   
1640 - 1700 Hz @ -123.7 dB/oct  
1700 - 1890 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
1890 - 2000 Hz @ +48.76 dB/oct  
2000 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 18.58 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.5 g rms at 250 Hz, 2.3 g rms at 500 Hz and 6.5 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweeps of 3.5 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min and 6.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr.

Total composite level = 20.12 g rms

(Zone H-4)

Parallel to flow direction (component Z axis)

Steady-state random vibration amplitudes-R4:

20 - 30 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
30 - 40 Hz @ +11.50 dB/oct  
40 - 110 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
110 - 130 Hz @ +21.70 dB/oct  
130 - 220 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
220 - 250 Hz @ -24.72 dB/oct  
250 - 330 Hz @  $0.035 (g \text{ rms})^2/\text{Hz}$   
330 - 380 Hz @ +45.84 dB/oct  
380 - 470 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
470 - 690 Hz @ -15.80 dB/oct  
690 - 740 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
740 - 800 Hz @ +65.82 dB/oct  
800 - 1000 Hz @  $0.22 (g \text{ rms})^2/\text{Hz}$   
1000 - 1310 Hz @ -22.21 dB/oct  
1310 - 1430 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
1430 - 1470 Hz @ +29.10 dB/oct  
1470 - 1590 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
1590 - 1640 Hz @ +141.49 dB/oct  
1640 - 1730 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
1730 - 1740 Hz @ -362.2 dB/oct  
1740 - 1830 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1830 - 2000 Hz @ -13.74 dB/oct  
2000 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 15.70 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.2 g rms at 250 Hz and 5.0 g rms at 600 Hz for 6.5 hr

Sinusoidal sweeps of 2.2 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min and 5.0 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min for 1.0 hr

Total composite level = 16.62 g rms

#### 4.5.8.5 SSME Vibration Criteria Zone H-5

This zone includes the low pressure fuel pump (LPFP) discharge duct flex joint.  
Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 7.7 g peak  
20 Hz @ 116 g peak  
50 Hz @ 76.0 g peak  
170 Hz @ 73.0 g peak  
320 Hz @ 221 g peak  
630 Hz @ 116 g peak  
1000 Hz @ 483 g peak  
1250 Hz @ 480 g peak  
2000 Hz @ 222 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 4.5 g peak  
20 Hz @ 70.0 g peak  
60 Hz @ 39.0 g peak  
200 Hz @ 83.0 g peak  
300 Hz @ 364 g peak  
520 Hz @ 115 g peak  
970 Hz @ 290 g peak  
2000 Hz @ 112 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 5.0 g peak  
20 Hz @ 65.0 g peak  
50 Hz @ 45.0 g peak  
100 Hz @ 82.0 g peak  
320 Hz @ 610 g peak  
610 Hz @ 440 g peak  
970 Hz @ 195 g peak  
2000 Hz @ 146 g peak



Parallel to engine thrust line direction (component X axis)

Steady-state random vibration amplitudes-R4:

20 -	90 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
90 -	110 Hz @ +13.13 dB/oct
110 -	120 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
120 -	140 Hz @ -40.61 dB/oct
140 -	200 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
200 -	230 Hz @ +60.60 dB/oct
230 -	240 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
240 -	280 Hz @ -48.37 dB/oct
280 -	310 Hz @ 0.021 (g rms) <sup>2</sup> /Hz
310 -	330 Hz @ +83.92 dB/oct
330 -	390 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
390 -	410 Hz @ -89.79 dB/oct
410 -	620 Hz @ 0.027 (g rms) <sup>2</sup> /Hz
620 -	710 Hz @ +68.87 dB/oct
710 -	830 Hz @ 0.6 (g rms) <sup>2</sup> /Hz
830 -	840 Hz @ -450.37 dB/oct
840 -	910 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
910 -	930 Hz @ +222.86 dB/oct
930 -	970 Hz @ 0.5 (g rms) <sup>2</sup> /Hz
970 -	990 Hz @ -223.33 dB/oct
990 -	1010 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
1010 -	1030 Hz @ +502.32 dB/oct
1030 -	1050 Hz @ 2.9 (g rms) <sup>2</sup> /Hz
1050 -	1080 Hz @ -113.37 dB/oct
1080 -	1280 Hz @ 1.0 (g rms) <sup>2</sup> /Hz
1280 -	2000 Hz @ -15.53 dB/oct
	2000 Hz @ 0.1 (g rms) <sup>2</sup> /Hz

Random composite reference level = 27.43 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.35 g rms at 500 Hz, 5.98 g rms at 600 Hz, 4.07 g rms at 1000 Hz, and 7.79 g rms at 1200 Hz for 6.5 hr

Sinusoidal sweeps of 5.98 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min, and 7.79 g rms from 700 Hz to 1240 Hz to 700 Hz at 540 Hz/min for 1.0 hr

Total composite level = 29.44 g rms

Parallel to flow direction (component Y axis)

Steady-state random vibration amplitudes-R4:

20	-	100 Hz @ 0.011 (g rms) <sup>2</sup> /Hz
100	-	120 Hz @ +43.47 dB/oct
120	-	130 Hz @ 0.153 (g rms) <sup>2</sup> /Hz
130	-	140 Hz @ -91.71 dB/oct
140	-	200 Hz @ 0.016 (g rms) <sup>2</sup> /Hz
200	-	240 Hz @ +30.26 dB/oct
240	-	280 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
280	-	300 Hz @ +39.98 dB/oct
300	-	310 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
310	-	320 Hz @ -173.76 dB/oct
320	-	390 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
390	-	400 Hz @ +120.28 dB/oct
400	-	420 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
420	-	460 Hz @ -20.61 dB/oct
460	-	600 Hz @ 0.059 (g rms) <sup>2</sup> /Hz
600	-	620 Hz @ +72.53 dB/oct
620	-	770 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
770	-	810 Hz @ +93.81 dB/oct
810	-	950 Hz @ 0.63 (g rms) <sup>2</sup> /Hz
950	-	970 Hz @ -217.32 dB/oct
970	-	1060 Hz @ 0.14 (g rms) <sup>2</sup> /Hz
1060	-	1080 Hz @ +122.74 dB/oct
1080	-	1120 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1120	-	1270 Hz @ -26.31 dB/oct
1270	-	1630 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
1630	-	2000 Hz @ -10.20 dB/oct
		2000 Hz @ 0.05 (g rms) <sup>2</sup> /Hz

Random composite reference level - 16.79 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.79 g rms at 600 Hz and 3.6 g rms at 1000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.79 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 3.6 g rms from 700 to 1040 Hz to 700 Hz at 340 Hz/min for 1.0 hr.

Total composite level = 17.83 g rms

Perpendicular to thrust and flow direction (component Z axis)

Steady-state random vibration amplitudes-R4:

20 -	80 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
80 -	100 Hz @ +35.60 dB/oct
100 -	120 Hz @ 0.21 (g rms) <sup>2</sup> /Hz
120 -	130 Hz @ -65.30 dB/oct
130 -	200 Hz @ 0.037 (g rms) <sup>2</sup> /Hz
200 -	220 Hz @ +82.86 dB/oct
220 -	290 Hz @ 0.51 (g rms) <sup>2</sup> /Hz
290 -	330 Hz @ -27.01 dB/oct
330 -	390 Hz @ 0.16 (g rms) <sup>2</sup> /Hz
390 -	410 Hz @ -21.84 dB/oct
410 -	500 Hz @ 0.23 (g rms) <sup>2</sup> /Hz
500 -	520 Hz @ +129.93 dB/oct
520 -	550 Hz @ 1.25 (g rms) <sup>2</sup> /Hz
550 -	600 Hz @ -48.24 dB/oct
600 -	680 Hz @ 0.31 (g rms) <sup>2</sup> /Hz
680 -	700 Hz @ -200.42 dB/oct
700 -	790 Hz @ 0.045 (g rms) <sup>2</sup> /Hz
790 -	850 Hz @ -19.51 dB/oct
850 -	1010 Hz @ 0.028 (g rms) <sup>2</sup> /Hz
1010 -	1060 Hz @ +51.50 dB/oct
1060 -	1680 Hz @ 0.064 (g rms) <sup>2</sup> /Hz
1680 -	1710 Hz @ +106.91 dB/oct
1710 -	1750 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
1750 -	1800 Hz @ -68.86 dB/oct
1800 -	2000 Hz @ 0.063 (g rms) <sup>2</sup> /Hz

Random composite reference level = 16.83 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 5.03 g rms at 500 Hz and 22.13 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweeps of 22.13 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr

Total composite level = 28.25 g rms

4.5.9 SSME Vibration Criteria Zone I

The zone includes the high-pressure fuel turbopump (HPFTP). Vibration amplitudes are as follows:

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
 25 Hz @ 15.0 g peak  
 250 Hz @ 90.0 g peak  
 320 Hz @ 100 g peak  
 640 Hz @ 130 g peak  
 1000 Hz @ 110 g peak  
 1250 Hz @ 280 g peak  
 1450 Hz @ 230 g peak  
 2000 Hz @ 340 g peak

Parallel to the pump centerline (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 100 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
 100 - 150 Hz @ +6.8 dB/oct  
 150 - 350 Hz @  $0.025 (g \text{ rms})^2/\text{Hz}$   
 350 - 400 Hz @ +46.88 dB/oct  
 400 - 850 Hz @  $0.20 (g \text{ rms})^2/\text{Hz}$   
 850 - 950 Hz @ +36.93 dB/oct  
 950 - 1120 Hz @  $0.78 (g \text{ rms})^2/\text{Hz}$   
 1120 - 1240 Hz @ +75.45 dB/oct  
 1240 - 1300 Hz @  $10.0 (g \text{ rms})^2/\text{Hz}$   
 1300 - 1340 Hz @ -126.45 dB/oct  
 1340 - 1380 Hz @  $2.8 (g \text{ rms})^2/\text{Hz}$   
 1380 - 1410 Hz @ +86.65 dB/oct  
 1410 - 1450 Hz @  $5.2 (g \text{ rms})^2/\text{Hz}$   
 1450 - 1640 Hz @ -46.38 dB/oct  
 1640 - 2000 Hz @  $0.78 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 51.93 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.1 g rms at 250 Hz and 9.0 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 10.5 g rms from 1700 Hz to 2000 Hz to 1700 Hz at 1 octave/min for 7.5 hr, 1.1 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min and 9.0 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min for 1.0 hr.

Total composite level = 53.75 g rms

(Zone I)

Radial to the pump centerline (engine Y and Z axes)

Steady-state random vibration amplitudes-R4:

20 - 160 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
160 - 200 Hz @ +25.59 dB/oct  
200 - 1000 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
1000 - 1200 Hz @ +18.14 dB/oct  
1200 - 1410 Hz @  $0.6 (g \text{ rms})^2/\text{Hz}$   
1410 - 1470 Hz @ +43.79 dB/oct  
1470 - 1520 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$   
1520 - 1540 Hz @ -124.72 dB/oct  
1540 - 1620 Hz @  $0.64 (g \text{ rms})^2/\text{Hz}$   
1620 - 1640 Hz @ +132.87 dB/oct  
1640 - 1710 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$   
1710 - 1870 Hz @ +10.44 dB/oct  
1870 - 1930 Hz @  $1.5 (g \text{ rms})^2/\text{Hz}$   
1930 - 2000 Hz @ -34.26 dB/oct  
2000 Hz @  $1.0 (g \text{ rms})^2/\text{Hz}$

Random composite reference level - 31.90 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 9.0 g rms at 600 Hz and 5.1 g rms at 1200 Hz for 6.5 hr.

Sinusoidal sweeps of 9.0 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min, 5.1 g rms from 900 Hz to 1240 Hz to 900 Hz at 340 Hz/min and 8.3 g rms from 1350 Hz to 1700 Hz to 1350 Hz at 510 Hz/min for 1.0 hr; and 9.0 g rms from 1700 Hz to 2000 Hz to 1700 Hz at 1 octave/min for 7.5 hr.

Total composite level = 33.70 g rms

#### 4.5.9.1 SSME Vibration Criteria Zone I-1

This zone includes the fuel flowmeter. Vibration amplitudes are as follows:

Transient shock spectrum-R4:

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
 160 Hz @ 160 g peak  
 250 Hz @ 160 g peak  
 330 Hz @ 280 g peak  
 500 Hz @ 130 g peak  
 1000 Hz @ 120 g peak  
 1250 Hz @ 150 g peak  
 1730 Hz @ 130 g peak  
 2000 Hz @ 140 g peak

Perpendicular to the flow direction (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 175 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
 175 - 210 Hz @ +13.24 dB/oct  
 210 - 270 Hz @  $0.29 (g \text{ rms})^2/\text{Hz}$   
 270 - 325 Hz @ -18.12 dB/oct  
 325 - 370 Hz @  $0.095 (g \text{ rms})^2/\text{Hz}$   
 370 - 380 Hz @ -34.47 dB/oct  
 380 - 450 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
 450 - 500 Hz @ +36.37 dB/oct  
 500 - 700 Hz @  $0.25 (g \text{ rms})^2/\text{Hz}$   
 700 - 800 Hz @ -7.41 dB/oct  
 800 - 825 Hz @  $0.18 (g \text{ rms})^2/\text{Hz}$   
 825 - 925 Hz @ +39.25 dB/oct  
 925 - 940 Hz @  $0.8 (g \text{ rms})^2/\text{Hz}$   
 940 - 1125 Hz @ -33.25 dB/oct  
 1125 - 1150 Hz @  $0.11 (g \text{ rms})^2/\text{Hz}$   
 1150 - 1400 Hz @ +42.77 dB/oct  
 1400 - 1500 Hz @  $1.8 (g \text{ rms})^2/\text{Hz}$   
 1500 - 1850 Hz @ -43.00 dB/oct  
 1850 - 2000 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 28.42 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.4 g rms at 500 Hz and 4.0 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 4.0 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr

Total composite level = 28.74 g rms

(Zone I-1)

Parallel to the flow direction (engine Y axis)

20	-	40 Hz @ 0.035 (g rms) <sup>2</sup> /Hz
40	-	80 Hz @ +4.55 dB/oct
80	-	225 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
225	-	250 Hz @ +35.79 dB/oct
250	-	350 Hz @ 0.35 (g rms) <sup>2</sup> /Hz
350	-	420 Hz @ -34.24 dB/oct
420	-	520 Hz @ 0.044 (g rms) <sup>2</sup> /Hz
520	-	550 Hz @ +44.06 dB/oct
550	-	650 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
650	-	700 Hz @ +44.62 dB/oct
700	-	800 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
800	-	850 Hz @ -54.56 dB/oct
850	-	1000 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
1000	-	1200 Hz @ +20.68 dB/oct
1200	-	1500 Hz @ 0.35 (g rms) <sup>2</sup> /Hz
1500	-	1620 Hz @ -35.85 dB/oct
1620	-	1745 Hz @ 0.14 (g rms) <sup>2</sup> /Hz
1745	-	1805 Hz @ -49.84 dB/oct
1805	-	2000 Hz @ 0.08 (g rms) <sup>2</sup> /Hz

Random composite reference level = 18.98 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.3 g rms at 500 Hz and 9.0 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 9.0 g rms for 350 Hz to 620 Hz to 350 Hz at 270 Hz/min for 1.0 hr

Total composite level = 21.13 g rms

Tangential to the flow direction (engine Z axis)

Steady-state random vibration amplitudes-R4:

20	-	50 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
50	-	95 Hz @ -6.88 dB/oct
95	-	160 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
160	-	195 Hz @ +26.92 dB/oct
195	-	210 Hz @ 0.176 (g rms) <sup>2</sup> /Hz
210	-	260 Hz @ +35.59 dB/oct
260	-	270 Hz @ 2.20 (g rms) <sup>2</sup> /Hz
270	-	350 Hz @ -37.08 dB/oct
350	-	360 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
360	-	370 Hz @ +87.73 dB/oct
370	-	400 Hz @ 0.20 (g rms) <sup>2</sup> /Hz
400	-	420 Hz @ -49.27 dB/oct
420	-	750 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
750	-	790 Hz @ +21.30 dB/oct
790	-	870 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
870	-	900 Hz @ +99.79 dB/oct
900	-	950 Hz @ 0.40 (g rms) <sup>2</sup> /Hz
950	-	1075 Hz @ -46.20 dB/oct
1075	-	1100 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
1100	-	1200 Hz @ +41.65 dB/oct
1200	-	1700 Hz @ 0.20 (g rms) <sup>2</sup> /Hz
1700	-	1900 Hz @ -39.20 dB/oct
1900	-	1940 Hz @ 0.047 (g rms) <sup>2</sup> /Hz
1940	-	1980 Hz @ +111.36 dB/oct
1980	-	2000 Hz @ 0.10 (g rms) <sup>2</sup> /Hz

Random composite reference level = 19.32 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.2 g rms at 500 Hz, 6.7 g rms at 620 Hz and 2.4 g rms at 1240 Hz for 6.5 hr.

Sinusoidal sweeps of 6.7 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min, and 2.4 g rms from 900 Hz to 1240 Hz to 900 Hz at 340 Hz/min for 1.0 hr.

Total composite level = 20.84 g rms



(Zone J)

Response Vibrations - Zones J Through U

4.5.10 SSME Vibration Criteria Zone J

This zone includes the main fuel valve (MFV). Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

X and Y axes (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
125 Hz @ 95.0 g peak  
160 Hz @ 129 g peak  
200 Hz @ 301 g peak  
250 Hz @ 247 g peak  
325 Hz @ 290 g peak  
500 Hz @ 182 g peak  
2000 Hz @ 1222 g peak

Z axis (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
125 Hz @ 100 g peak  
160 Hz @ 128 g peak  
250 Hz @ 412 g peak  
325 Hz @ 379 g peak  
500 Hz @ 203 g peak  
2000 Hz @ 1397 g peak

(Zone J)

Parallel to flow direction (component X axis)

Steady-state random vibration amplitude-des-R4: (criteria based on DVS testing representing accumulated engine RPL operation time)

20 -	120 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
120 -	180 Hz @ +22.2 dB/oct
180 -	205 Hz @ 0.20 (g rms) <sup>2</sup> /Hz
205 -	250 Hz @ -22.5 dB/oct
250 -	430 Hz @ 0.045 (g rms) <sup>2</sup> /Hz
430 -	540 Hz @ +7.6 dB/oct
540 -	780 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
780 -	960 Hz @ +19.1 dB/oct
960 -	1300 Hz @ 0.39 (g rms) <sup>2</sup> /Hz
1300 -	1325 Hz @ +486.1 dB/oct
1325 -	1335 Hz @ 6.50 (g rms) <sup>2</sup> /Hz
1335 -	1360 Hz @ -489.0 dB/oct
1360 -	1490 Hz @ 0.30 (g rms) <sup>2</sup> /Hz
1490 -	1700 Hz @ -17.4 dB/oct
1700 -	2000 Hz @ 0.14 (g rms) <sup>2</sup> /Hz

Random composite reference level = 21.59 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 6.74 g rms at 600 Hz and 5.23 g rms at 1200 Hz for 3.6 hr.

Total composite level = 23.20 g rms

(Zone J)

Parallel to flow direction (component X axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine FPL operation time)

20 -	75 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
75 -	85 Hz @ -22.0 dB/oct
85 -	95 Hz @ 0.012 (g rms) <sup>2</sup> /Hz
95 -	140 Hz @ +25.0 dB/oct
140 -	145 Hz @ 0.30 (g rms) <sup>2</sup> /Hz
145 -	150 Hz @ -128.0 dB/oct
150 -	170 Hz @ 0.071 (g rms) <sup>2</sup> /Hz
170 -	180 Hz @ +97.3 dB/oct
180 -	200 Hz @ 0.45 (g rms) <sup>2</sup> /Hz
200 -	240 Hz @ -49.8 dB/oct
240 -	260 Hz @ 0.022 (g rms) <sup>2</sup> /Hz
260 -	300 Hz @ +35.7 dB/oct
300 -	315 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
315 -	345 Hz @ -43.8 dB/oct
345 -	370 Hz @ 0.032 (g rms) <sup>2</sup> /Hz
370 -	475 Hz @ +10.9 dB/oct
475 -	700 Hz @ 0.079 (g rms) <sup>2</sup> /Hz
700 -	730 Hz @ +55.0 dB/oct
730 -	795 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
795 -	970 Hz @ +16.3 dB/oct
970 -	1015 Hz @ 0.50 (g rms) <sup>2</sup> /Hz
1015 -	1070 Hz @ +121.4 dB/oct
1070 -	1120 Hz @ 4.2 (g rms) <sup>2</sup> /Hz
1120 -	1330 Hz @ -73.0 dB/oct
1330 -	1670 Hz @ 0.065 (g rms) <sup>2</sup> /Hz
1670 -	1800 Hz @ +17.3 dB/oct
1800 -	2000 Hz @ 0.10 (g rms) <sup>2</sup> /Hz

Random composite reference level = 26.58 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 8.05 g rms at 600 Hz, 8.94 g rms at 1000 Hz and 2.83 g rms at 2000 Hz for 2.9 hr

Sinusoidal sweeps of 8.05 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 2.83 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 29.31 g rms

(Zone J)

Parallel to actuator shaft direction (component Y axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine RPL operation time)

20 -	100 Hz @	0.005 (g rms) <sup>2</sup> /Hz
100 -	150 Hz @	+21.0 dB/oct
150 -	180 Hz @	0.085 (g rms) <sup>2</sup> /Hz
180 -	220 Hz @	-26.0 dB/oct
220 -	380 Hz @	0.015 (g rms) <sup>2</sup> /Hz
380 -	460 Hz @	+14.6 dB/oct
460 -	630 Hz @	0.038 (g rms) <sup>2</sup> /Hz
630 -	770 Hz @	-13.9 dB/oct
770 -	1300 Hz @	0.015 (g rms) <sup>2</sup> /Hz
1300 -	1320 Hz @	+178.0 dB/oct
1320 -	1340 Hz @	0.09 (g rms) <sup>2</sup> /Hz
1340 -	1360 Hz @	-68.4 dB/oct
1360 -	1450 Hz @	0.015 (g rms) <sup>2</sup> /Hz
1450 -	1940 Hz @	+19.6 dB/oct
1940 -	2000 Hz @	0.1 (g rms) <sup>2</sup> /Hz

Random composite reference level = 7.90 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 1.7 g rms at 600 Hz for 3.6 hr

Total composite level = 8.10 g rms

(Zone J)

Parallel to actuator shaft direction (component Y axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine FPL operation time)

20 - 50 Hz @  $0.049 (g \text{ rms})^2/\text{Hz}$   
50 - 100 Hz @ -3.89 dB/oct  
100 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
100 - 140 Hz @ +27.5 dB/oct  
140 - 150 Hz @  $0.43 (g \text{ rms})^2/\text{Hz}$   
150 - 175 Hz @ -32.4 dB/oct  
175 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
175 - 190 Hz @ +32.6 dB/oct  
190 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
190 - 210 Hz @ -59.1 dB/oct  
210 - 280 Hz @  $0.028 (g \text{ rms})^2/\text{Hz}$   
280 - 300 Hz @ +29.5 dB/oct  
300 - 315 Hz @  $0.055 (g \text{ rms})^2/\text{Hz}$   
315 - 320 Hz @ -214 dB/oct  
320 - 400 Hz @  $0.018 (g \text{ rms})^2/\text{Hz}$   
400 - 610 Hz @ +7.0 dB/oct  
610 - 900 Hz @  $0.048 (g \text{ rms})^2/\text{Hz}$   
900 - 915 Hz @ +219.3 dB/oct  
915 - 950 Hz @  $0.16 (g \text{ rms})^2/\text{Hz}$   
950 - 1100 Hz @ +62.8 dB/oct  
1100 - 1120 Hz @  $3.4 (g \text{ rms})^2/\text{Hz}$   
1120 - 1230 Hz @ -136.0 dB/oct  
1230 - 2000 Hz @  $0.049 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 20.23 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.6 g rms at 600 Hz and 1.5 g rms at 2000 Hz for 2.9 hr

Sinusoidal sweeps of 3.6 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 1.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 20.60 g rms

(Zone J)

Perpendicular to flow and perpendicular to actuator shaft direction  
(component Z axis)

Steady-state random vibration amplitudes-R4: (criteria based on DVS testing representing accumulated engine RPL operation time)

20 - 110 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$   
110 - 170 Hz @ +25.0 dB/oct  
170 - 200 Hz @  $0.26 (g \text{ rms})^2/\text{Hz}$   
200 - 260 Hz @ -29.4 dB/oct  
260 - 400 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
400 - 460 Hz @ +13.82 dB/oct  
460 - 1310 Hz @  $0.038 (g \text{ rms})^2/\text{Hz}$   
1310 - 1320 Hz @ +1072 dB/oct  
1320 - 1340 Hz @  $0.57 (g \text{ rms})^2/\text{Hz}$   
1340 - 1350 Hz @ -1092 dB/oct  
1350 - 1660 Hz @  $0.038 (g \text{ rms})^2/\text{Hz}$   
1660 - 1850 Hz @ +26.9 dB/oct  
1850 - 2000 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 10.50 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.7 g rms at 600 Hz and 1.5 g rms at 1200 Hz for 3.6 hr.

Total composite level = 10.74 g rms

(Zone J)

Perpendicular to flow and perpendicular to actuator shaft direction  
(component Z axis)

Steady-state random vibration amplitudes-R4: (criteria based on testing representing accumulated engine FPL operation time)

20 -	120 Hz @ 0.022 (g rms) <sup>2</sup> /Hz
120 -	140 Hz @ +44.1 dB/oct
140 -	175 Hz @ 0.21 (g rms) <sup>2</sup> /Hz
175 -	180 Hz @ +79.0 dB/oct
180 -	195 Hz @ 0.44 (g rms) <sup>2</sup> /Hz
195 -	210 Hz @ -111.9 dB/oct
210 -	240 Hz @ 0.028 (g rms) <sup>2</sup> /Hz
240 -	245 Hz @ +212.5 dB/oct
245 -	255 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
255 -	260 Hz @ -88.1 dB/oct
260 -	285 Hz @ 0.062 (g rms) <sup>2</sup> /Hz
285 -	300 Hz @ +71.5 dB/oct
300 -	310 Hz @ 0.23 (g rms) <sup>2</sup> /Hz
310 -	325 Hz @ -36.3 dB/oct
325 -	365 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
365 -	450 Hz @ -11.4 dB/oct
450 -	840 Hz @ 0.059 (g rms) <sup>2</sup> /Hz
840 -	890 Hz @ +178.0 dB/oct
890 -	910 Hz @ 1.8 (g rms) <sup>2</sup> /Hz
910 -	1000 Hz @ -95.6 dB/oct
1000 -	1040 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
1040 -	1085 Hz @ +106.0 dB/oct
1085 -	1120 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
1120 -	1160 Hz @ -73.4 dB/oct
1160 -	1250 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
1250 -	1270 Hz @ -106.4 dB/oct
1270 -	2000 Hz @ 0.097 (g rms) <sup>2</sup> /Hz

Random composite reference level = 17.53 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.3 g rms at 600 Hz and 2.83 g rms at 2000 Hz for 2.9 hr.

Sinusoidal sweeps of 4.3 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 2.83 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.27 g rms

(Zone J-1)

#### 4.5.10.1 SSME Vibration Criteria Zone J-1

This zone includes the main fuel valve (MFV) actuator neck. Vibration amplitudes are as follows:

Transient shock spectrum-R2: (ccomponent axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 5.0 g peak  
100 Hz @ 60.0 g peak  
500 Hz @ 80.0 g peak  
2000 Hz @ 170 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
80 Hz @ 75.0 g peak  
1000 Hz @ 75.0 g peak  
2000 Hz @ 125 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
70 Hz @ 35.0 g peak  
800 Hz @ 40.0 g peak  
2000 Hz @ 180 g peak



(Zone J-1)

Parallel to flow direction (component X axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
20 -	50 Hz @ +1.33 dB/oct
	50 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
50 -	80 Hz @ +15.73 dB/oct
80 -	125 Hz @ 0.35 (g rms) <sup>2</sup> /Hz
125 -	170 Hz @ -14.45 dB/oct
170 -	620 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
620 -	700 Hz @ +28.26 dB/oct
700 -	900 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
900 -	1280 Hz @ -21.6 dB/oct
1280 -	1800 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
1800 -	2000 Hz @ -13.8 dB/oct
	2000 Hz @ 0.01 (g rms) <sup>2</sup> /Hz

Random composite reference level = 13.13 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.0 g rms at 500 Hz, 3.5 g rms at 600 Hz and 0.71 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 4.0 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 0.71 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 14.18 g rms

(Zone J-1)

Perpendicular to flow and perpendicular to actuator shaft direction  
(component Y axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
20 -	60 Hz @ +1.2 dB/oct
	60 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
60 -	80 Hz @ +7.3 dB/oct
80 -	170 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
170 -	200 Hz @ +13.0 dB/oct
200 -	650 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
650 -	800 Hz @ -14.3 dB/oct
800 -	1100 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
1100 -	1200 Hz @ +27.0 dB/oct
1200 -	2000 Hz @ 0.065 (g rms) <sup>2</sup> /Hz

Random composite reference level = 10.76 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.14 g rms at 500 Hz, 2.45 g rms at 600 Hz, and 1.1 g rms at 1200 Hz for 6.5 hr

Sinusoidal sweeps of 2.45 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min, and 1.1 g rms from 900 Hz to 1240 Hz to 900 Hz at 340 Hz/min for 1.0 hr.

Total composite level = 11.14 g rms

(Zone J-1)

Parallel to actuator shaft direction (component Z axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
20 -	50 Hz @ +0.95 dB/oct
	50 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
50 -	80 Hz @ +17.3 dB/oct
80 -	120 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
120 -	150 Hz @ -9.4 dB/oct
150 -	630 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
630 -	800 Hz @ -17.6 dB/oct
800 -	1000 Hz @ 0.037 (g rms) <sup>2</sup> /Hz
1000 -	1200 Hz @ +10.5 dB/oct
1200 -	2000 Hz @ 0.07 (g rms) <sup>2</sup> /Hz

Total composite level = 13.47 g rms

(Zone K)

#### 4.5.11 SSME Vibration Criteria Zone K

This zone includes the main oxidizer valve (MOV). The dynamic environments are as follows:

Transient shock spectrum-R2: (component axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 2.9 g peak  
100 Hz @ 35.0 g peak  
600 Hz @ 50.0 g peak  
2000 Hz @ 150 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 2.0 g peak  
100 Hz @ 40.0 g peak  
2000 Hz @ 90.0 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
80 Hz @ 15.0 g peak  
1000 Hz @ 20.0 g peak  
2000 Hz @ 100 g peak

(Zone K)

Parallel to flow direction (component X axis)

Steady-state random vibration amplitudes-R4:

20 -	80 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
80 -	90 Hz @ +19.76 dB/oct
90 -	110 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
110 -	120 Hz @ -26.75 dB/oct
120 -	210 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
210 -	230 Hz @ +16.9 dB/oct
230 -	250 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
250 -	330 Hz @ +15.29 dB/oct
330 -	360 Hz @ 0.41 (g rms) <sup>2</sup> /Hz
360 -	400 Hz @ -28.73 dB/oct
400 -	600 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
600 -	660 Hz @ -34.7 dB/oct
660 -	700 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
700 -	800 Hz @ +32.35 dB/oct
800 -	880 Hz @ 0.21 (g rms) <sup>2</sup> /Hz
880 -	1000 Hz @ -39.05 dB/oct
1000 -	1100 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
1100 -	1290 Hz @ +29.43 dB/oct
1290 -	1440 Hz @ 0.19 (g rms) <sup>2</sup> /Hz
1440 -	1480 Hz @ +120.7 dB/oct
1480 -	1510 Hz @ 0.57 (g rms) <sup>2</sup> /Hz
1510 -	1530 Hz @ -179.6 dB/oct
1530 -	1550 Hz @ 0.26 (g rms) <sup>2</sup> /Hz
1550 -	1810 Hz @ +23.0 dB/oct
1810 -	2000 Hz @ 0.85 (g rms) <sup>2</sup> /Hz

Random composite reference level = 22.88 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.6 g rms at 500 Hz, 2.3 g rms at 600 Hz, 3.3 g rms at 1000 Hz and 14.8 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.3 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min, and 14.8 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 27.59 g rms

(Zone K)

Perpendicular to flow and perpendicular to actuator shaft direction  
(component Y axis)

Steady-state random vibration amplitudes-R4:

20 -	175 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
175 -	200 Hz @ +17.77 dB/oct
200 -	400 Hz @ 0.44 (g rms) <sup>2</sup> /Hz
400 -	470 Hz @ -14.72 dB/oct
470 -	530 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
530 -	590 Hz @ +13.19 dB/oct
590 -	650 Hz @ 0.32 (g rms) <sup>2</sup> /Hz
650 -	700 Hz @ +21.99 dB/oct
700 -	760 Hz @ 0.55 (g rms) <sup>2</sup> /Hz
760 -	780 Hz @ -34.05 dB/oct
780 -	840 Hz @ 0.41 (g rms) <sup>2</sup> /Hz
840 -	860 Hz @ -39.97 dB/oct
860 -	1050 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1050 -	1200 Hz @ +16.72 dB/oct
1200 -	1350 Hz @ 0.63 (g rms) <sup>2</sup> /Hz
1350 -	1390 Hz @ +57.45 dB/oct
1390 -	1490 Hz @ 1.1 (g rms) <sup>2</sup> /Hz
1490 -	1540 Hz @ +39.7 dB/oct
1540 -	1570 Hz @ 1.7 (g rms) <sup>2</sup> /Hz
1570 -	1640 Hz @ -68.51 dB/oct
1640 -	1900 Hz @ 0.63 (g rms) <sup>2</sup> /Hz
1900 -	1940 Hz @ +193.25 dB/oct
1940 -	2000 Hz @ 2.4 (g rms) <sup>2</sup> /Hz

Random composite reference level = 34.75 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.4 g rms at 500 Hz, 4.0 g rms at 600 Hz, 2.7 g rms at 1000 Hz, and 12.3 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.0 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min, and 12.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 37.26 g rms

Perpendicular to actuator shaft direction (component Z axis)

## Steady-state random vibration-R4:

20	-	70 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
70	-	90 Hz @ +10.14 dB/oct
90	-	110 Hz @ 0.21 (g rms) <sup>2</sup> /Hz
110	-	120 Hz @ -33.39 dB/oct
120	-	190 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
190	-	210 Hz @ +20.84 dB/oct
210	-	270 Hz @ 0.16 (g rms) <sup>2</sup> /Hz
270	-	300 Hz @ +14.94 dB/oct
300	-	310 Hz @ 0.27 (g rms) <sup>2</sup> /Hz
310	-	320 Hz @ -11.17 dB/oct
320	-	380 Hz @ 0.24 (g rms) <sup>2</sup> /Hz
380	-	430 Hz @ +17.38 dB/oct
430	-	530 Hz @ 0.49 (g rms) <sup>2</sup> /Hz
530	-	580 Hz @ -26.74 dB/oct
580	-	630 Hz @ 0.22 (g rms) <sup>2</sup> /Hz
630	-	640 Hz @ +91.13 dB/oct
640	-	690 Hz @ 0.36 (g rms) <sup>2</sup> /Hz
690	-	720 Hz @ +58.22 dB/oct
720	-	760 Hz @ 0.82 (g rms) <sup>2</sup> /Hz
760	-	790 Hz @ -44.95 dB/oct
790	-	850 Hz @ 0.46 (g rms) <sup>2</sup> /Hz
850	-	880 Hz @ -31.5 dB/oct
880	-	1290 Hz @ 0.32 (g rms) <sup>2</sup> /Hz
1290	-	1420 Hz @ +31.71 dB/oct
1420	-	1500 Hz @ 0.88 (g rms) <sup>2</sup> /Hz
1500	-	1600 Hz @ -36.78 dB/oct
1600	-	1850 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
1850	-	2000 Hz @ +42.42 dB/oct
	-	2000 Hz @ 1.2 (g rms) <sup>2</sup> /Hz

Random composite reference level = 28.70 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.5 g rms at 500 Hz, 4.2 g rms at 600 Hz, 4.5 g rms at 1000 Hz and 21.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.5 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 21.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 36.26 g rms

4.5.11.1 SSME Vibration Criteria Zone K-1

This zone includes the main oxidizer valve (MOV) actuator neck. Vibration amplitudes are as follows:

Transient shock spectrum-R2: (component axes)

X axis (Q=10) 120 pulses

10 Hz @ 5.0 g peak  
100 Hz @ 60.0 g peak  
500 Hz @ 80.0 g peak  
2000 Hz @ 170 g peak

Y axis (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
80 Hz @ 75.0 g peak  
1000 Hz @ 75.0 g peak  
2000 Hz @ 125 g peak

Z axis (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
70 Hz @ 35.0 g peak  
800 Hz @ 40.0 g peak  
2000 Hz @ 180 g peak



Parallel to valve flow direction (component X axis)

## Steady-state random vibration amplitude-R4:

	20 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
20 -	50 Hz @ +1.33 dB/oct
	50 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
50 -	90 Hz @ +12.12 dB/oct
90 -	100 Hz @ 0.32 (g rms) <sup>2</sup> /Hz
100 -	180 Hz @ -12.12 dB/oct
180 -	200 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
200 -	220 Hz @ 28.09 dB/oct
220 -	250 Hz @ 0.073 (g rms) <sup>2</sup> /Hz
250 -	320 Hz @ -10.84 dB/oct
320 -	370 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
370 -	400 Hz @ 37.87 dB/oct
400 -	500 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
500 -	540 Hz @ -42.49 dB/oct
540 -	570 Hz @ 0.027 (g rms) <sup>2</sup> /Hz
570 -	720 Hz @ +31.86 dB/oct
720 -	740 Hz @ 0.32 (g rms) <sup>2</sup> /Hz
740 -	750 Hz @ -55.36 dB/oct
750 -	830 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
830 -	850 Hz @ -87.63 dB/oct
850 -	880 Hz @ 0.5 (g rms) <sup>2</sup> /Hz
880 -	1100 Hz @ -28.83 dB/oct
1100 -	1160 Hz @ 0.059 (g rms) <sup>2</sup> /Hz
1160 -	1210 Hz @ +50.64 dB/oct
1210 -	1340 Hz @ 0.12 (g rms) <sup>2</sup> /Hz
1340 -	1420 Hz @ +11.33 dB/oct
1420 -	1450 Hz @ 1.2 (g rms) <sup>2</sup> /Hz
1450 -	1490 Hz @ -139.51 dB/oct
1490 -	1900 Hz @ 0.34 (g rms) <sup>2</sup> /Hz
1900 -	2000 Hz @ +103.99 dB/oct
	2000 Hz @ 2.0 (g rms) <sup>2</sup> /Hz

Random composite reference level = 22.61 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 8.9 g rms at 500 Hz, 5.5 g rms at 600 Hz, 9.5 g rms at 1000 Hz and 28.3 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 9.5 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 28.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 38.88 g rms

Perpendicular to valve flow and perpendicular to actuator shaft direction  
(component Y axis)

Steady-state random vibration amplitude-R4:

	20 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
20 -	60 Hz @ +1.18 dB/oct
	60 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
60 -	80 Hz @ +10.00 dB/oct
80 -	100 Hz @ 0.052 (g rms) <sup>2</sup> /Hz
100 -	110 Hz @ -9.91 dB/oct
110 -	200 Hz @ 0.038 (g rms) <sup>2</sup> /Hz
200 -	240 Hz @ +12.29 dB/oct
240 -	260 Hz @ 0.082 (g rms) <sup>2</sup> /Hz
260 -	370 Hz @ -17.74 dB/oct
370 -	400 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
400 -	550 Hz @ +7.45 dB/oct
550 -	570 Hz @ 0.022 (g rms) <sup>2</sup> /Hz
570 -	770 Hz @ -19.30 dB/oct
770 -	1020 Hz @ 0.0032 (g rms) <sup>2</sup> /Hz
1020 -	1100 Hz @ +32.62 dB/oct
1100 -	1140 Hz @ 0.008 (g rms) <sup>2</sup> /Hz
1140 -	1160 Hz @ -81.35 dB/oct
1160 -	1300 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
1300 -	1480 Hz @ +45.17 dB/oct
1480 -	1740 Hz @ 0.035 (g rms) <sup>2</sup> /Hz
1740 -	1790 Hz @ +121.68 dB/oct
1790 -	1920 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
1920 -	2000 Hz @ +111.65 dB/oct
	2000 Hz @ 0.5 (g rms) <sup>2</sup> /Hz

Random composite reference level = 8.43 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.41 g rms at 500 Hz, 1.73 g rms at 600 Hz, 0.77 g rms at 1000 Hz, and 7.74 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 1.73 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 7.74 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 11.69 g rms

Parallel to actuator shaft direction (component Z axis)

## Steady-state random vibration amplitude-R4:

20 -	40 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
40 -	70 Hz @ +6.13 dB/oct
70 -	110 Hz @ 0.25 (g rms) <sup>2</sup> /Hz
110 -	130 Hz @ -53.28 dB/oct
130 -	170 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
170 -	200 Hz @ +33.19 dB/oct
200 -	280 Hz @ 0.078 (g rms) <sup>2</sup> /Hz
280 -	320 Hz @ -13.96 dB/oct
320 -	350 Hz @ 0.042 (g rms) <sup>2</sup> /Hz
350 -	390 Hz @ +17.92 dB/oct
390 -	420 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
420 -	470 Hz @ -48.63 dB/oct
470 -	650 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
650 -	720 Hz @ +46.45 dB/oct
720 -	950 Hz @ 0.063 (g rms) <sup>2</sup> /Hz
950 -	1030 Hz @ +20.75 dB/oct
1030 -	1180 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
1180 -	1200 Hz @ -80.95 dB/oct
1200 -	1320 Hz @ 0.07 (g rms) <sup>2</sup> /Hz
1320 -	1440 Hz @ +50.35 dB/oct
1440 -	1620 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
1620 -	1670 Hz @ -108.80 dB/oct
1670 -	1900 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
1900 -	2000 Hz @ +46.27 dB/oct
	2000 Hz @ 0.22 (g rms) <sup>2</sup> /Hz

Random composite reference level = 14.45 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.41 g rms at 500 Hz, 1.41 g rms at 600 Hz, 5.5 g rms at 1000 Hz, and 9.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 5.5 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min, 9.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.26 g rms

#### 4.5.12 SSME Vibration Criteria Zone L

This zone includes the pneumatic control assembly (PCA). The dynamic environments are as follows:

##### Transient shock spectrum-R3:

###### X-Axis (Q=10) 120 pulses (engine axis)

10 Hz @ 10.0 g peak  
20 Hz @ 25.0 g peak  
200 Hz @ 25.0 g peak  
350 Hz @ 55.0 g peak  
650 Hz @ 55.0 g peak  
2000 Hz @ 170 g peak

###### Y and Z Axes (Q=10) 120 pulses (engine axes)

10 Hz @ 10.0 g peak  
150 Hz @ 25.0 g peak  
350 Hz @ 25.0 g peak  
900 Hz @ 90.0 g peak  
2000 Hz @ 210 g peak

###### Axial direction (engine X axis)

##### Steady-state random vibration amplitudes-R4:

20 - 250 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
250 - 280 Hz @ +10.77 dB/oct  
280 - 600 Hz @  $0.015 (g \text{ rms})^2/\text{Hz}$   
600 - 690 Hz @ +26.13 dB/oct  
690 - 950 Hz @  $0.46 (g \text{ rms})^2/\text{Hz}$   
950 - 1200 Hz @ -7.01 dB/oct  
1200 - 1280 Hz @  $0.267 (g \text{ rms})^2/\text{Hz}$   
1280 - 1320 Hz @ +63.31 dB/oct  
1320 - 1390 Hz @  $0.51 (g \text{ rms})^2/\text{Hz}$   
1390 - 1450 Hz @ -46.01 dB/oct  
1450 - 2000 Hz @  $0.267 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 20.14 g rms

##### Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.5 g rms at 500 Hz, 2.5 g rms at 600 Hz and 2.5 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 3.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 2.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 20.74 g rms

(Zone L)

Radial direction (engine X and Z axis)

Steady-state random vibration amplitudes-R4:

20 - 180 Hz @  $0.033 (g \text{ rms})^2/\text{Hz}$   
180 - 200 Hz @ -9.10 dB/oct  
200 - 600 Hz @  $0.024 (g \text{ rms})^2/\text{Hz}$   
600 - 640 Hz @ +8.83 dB/oct  
640 - 740 Hz @  $0.029 (g \text{ rms})^2/\text{Hz}$   
740 - 880 Hz @ +37.42 dB/oct  
880 - 1000 Hz @  $0.25 (g \text{ rms})^2/\text{Hz}$   
1000 - 1150 Hz @ -34.67 dB/oct  
1150 - 1740 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
1740 - 2000 Hz @ +14.98 dB/oct  
2000 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 11.44 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.4 g rms at 500 Hz, 0.9 g rms at 600 Hz, 3.4 g rms at 1000 Hz and 10.6 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 2.4 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 10.6 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 16.17 g rms

(Zone M)

#### 4.5.13 SSME Vibration Criteria Zone M

This zone includes the chamber coolant valve (CCV) and coolant control valve actuator neck. The dynamic environments are as follows:

Transient shock spectrum-R2: (engine axe)

##### X axis (Q=10) 120 pulses

25 Hz @ 30.0 g peak  
100 Hz @ 30.0 g peak  
300 Hz @ 30.0 g peak  
1000 Hz @ 200 g peak  
2000 Hz @ 250 g peak

##### Y axis(Q=10) 120 pulses

25 Hz @ 20.0 g peak  
200 Hz @ 30.0 g peak  
300 Hz @ 85.0 g peak  
800 Hz @ 100 g peak  
1250 Hz @ 260 g peak  
2000 Hz @ 320 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 3.0 g peak  
300 Hz @ 110 g peak  
700 Hz @ 130 g peak  
1000 Hz @ 230 g peak  
2000 Hz @ 300 g peak

(Zone M)

Axial direction (engine X axis)

Steady-state random vibration amplitudes-R4:

20 -	60 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
60 -	80 Hz @ +23.37 dB/oct
80 -	90 Hz @ 0.14 (g rms) <sup>2</sup> /Hz
90 -	100 Hz @ -44.98 dB/oct
100 -	120 Hz @ 0.029 (g rms) <sup>2</sup> /Hz
120 -	130 Hz @ +61.86 dB/oct
130 -	190 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
190 -	200 Hz @ +32.28 dB/oct
200 -	210 Hz @ 0.26 (g rms) <sup>2</sup> /Hz
210 -	230 Hz @ -35.10 dB/oct
230 -	250 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
250 -	280 Hz @ +66.49 dB/oct
280 -	330 Hz @ 1.1 (g rms) <sup>2</sup> /Hz
330 -	370 Hz @ -43.20 dB/oct
370 -	420 Hz @ 0.19 (g rms) <sup>2</sup> /Hz
420 -	440 Hz @ +140.65 dB/oct
440 -	470 Hz @ 1.67 (g rms) <sup>2</sup> /Hz
470 -	520 Hz @ -78.40 dB/oct
520 -	790 Hz @ 0 (g rms) <sup>2</sup> /Hz
790 -	820 Hz @ - dB/oct
820 -	900 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
900 -	1000 Hz @ +26.18 dB/oct
1000 -	1490 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
1490 -	1620 Hz @ +16.91 dB/oct
1620 -	1810 Hz @ 0.24 (g rms) <sup>2</sup> /Hz
1810 -	1880 Hz @ +59.23 dB/oct
1880 -	2000 Hz @ 0.5 (g rms) <sup>2</sup> /Hz

Random composite reference level = 22.19 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.56 g rms at 600 Hz and 3.17 g rms at 2000 Hz for 6.5 hr and 3.22 g rms at 1150 Hz for 7.5 hr.

Sinusoidal sweeps of 4.56 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 3.17 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 23.10 g rms

Radial direction (engine Y axis)

## Steady-state random vibration amplitudes-R4:

20 -	70 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
70 -	130 Hz @ +3.83 dB/oct
130 -	150 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
150 -	160 Hz @ -62.18 dB/oct
160 -	180 Hz @ 0.029 (g rms) <sup>2</sup> /Hz
180 -	200 Hz @ +92.94 dB/oct
200 -	220 Hz @ 0.75 (g rms) <sup>2</sup> /Hz
220 -	250 Hz @ -55.52 dB/oct
250 -	260 Hz @ 0.071 (g rms) <sup>2</sup> /Hz
260 -	280 Hz @ +116.03 dB/oct
	280 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
280 -	300 Hz @ +86.78 dB/oct
	300 Hz @ 0.95 (g rms) <sup>2</sup> /Hz
300 -	350 Hz @ -38.84 dB/oct
	350 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
350 -	390 Hz @ +55.33 dB/oct
	390 Hz @ 0.95 (g rms) <sup>2</sup> /Hz
390 -	400 Hz @ -219.47 dB/oct
400 -	440 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
440 -	450 Hz @ +266.89 dB/oct
450 -	480 Hz @ 1.1 (g rms) <sup>2</sup> /Hz
480 -	600 Hz @ -21.11 dB/oct
600 -	660 Hz @ 0.23 (g rms) <sup>2</sup> /Hz
660 -	690 Hz @ -168.87 dB/oct
690 -	770 Hz @ 0.019 (g rms) <sup>2</sup> /Hz
770 -	840 Hz @ +36.77 dB/oct
840 -	960 Hz @ 0.055 (g rms) <sup>2</sup> /Hz
960 -	1000 Hz @ +95.20 dB/oct
1000 -	1350 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
1350 -	1380 Hz @ -109.37 dB/oct
1380 -	1650 Hz @ 0.09 (g rms) <sup>2</sup> /Hz
1650 -	1860 Hz @ +14.46 dB/oct
1860 -	2000 Hz @ 0.16 (g rms) <sup>2</sup> /Hz

Random composite reference level = 19.56 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.44 g rms at 600 Hz and 2.68 g rms at 2000 Hz for 6.5 hr;  
3.89 g rms at 1100 Hz and 3.09 g rms at 1200 Hz for 7.5 hr.

Sinusoidal sweeps of 3.44 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and  
2.68 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 20.49 g rms



(Zone M)

Tangential direction (engine Z axis)

Steady-state random vibration amplitudes-R4:

20 -	60 Hz @ 0.018 (g rms) <sup>2</sup> /Hz
60 -	80 Hz @ +23.50 dB/oct
80 -	90 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
90 -	100 Hz @ -29.76 dB/oct
100 -	110 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
110 -	130 Hz @ +21.73 dB/oct
130 -	150 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
150 -	170 Hz @ +27.21 dB/oct
170 -	190 Hz @ 0.62 (g rms) <sup>2</sup> /Hz
190 -	200 Hz @ +104.04 dB/oct
200 -	210 Hz @ 3.65 (g rms) <sup>2</sup> /Hz
210 -	240 Hz @ -75.18 dB/oct
240 -	310 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
310 -	360 Hz @ +13.95 dB/oct
360 -	450 Hz @ 0.26 (g rms) <sup>2</sup> /Hz
450 -	620 Hz @ -24.09 dB/oct
620 -	900 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
900 -	1000 Hz @ +85.59 dB/oct
1000 -	1400 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
1400 -	1600 Hz @ -19.29 dB/oct
1600 -	1700 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
1700 -	1800 Hz @ +34.93 dB/oct
1800 -	2000 Hz @ 0.33 (g rms) <sup>2</sup> /Hz

Random composite reference level = 22.63 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.85 g rms at 600 Hz and 6.0 g rms at 1200 Hz for 6.5 hr.

Sinusoidal sweeps of 2.85 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 6.0 g rms from 900 Hz to 1240 Hz to 900 Hz at 340 Hz/min for 1.0 hr.

Total composite level = 23.58 g rms

4.5.14 SSME Vibration Criteria Zone N

This zone includes the fuel preburner oxidizer valve (FPOV). The dynamic environments are as follows:

Transient shock spectrum-R2: (engine axes)

X axis (Q=10) 120 pulses

10 Hz @ 2.0 g peak  
40 Hz @ 6.0 g peak  
220 to 1400 Hz @ 120 g peak  
2000 Hz @ 250 g peak

Y axis(Q=10) 120 pulses

10 Hz @ 3.0 g peak  
120 Hz @ 35.0 g peak  
400 Hz @ 100 g peak  
900 Hz @ 40.0 g peak  
2000 Hz @ 75.0 g peak

Z axis (Q=10) 120 pulses

10 Hz @ 30.0 g peak  
100 Hz @ 60.0 g peak  
2000 Hz @ 300 g peak

(Zone N)

Axial direction (engine X axis)

Steady-state random vibration amplitudes-R4:

20 -	50 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
50 -	70 Hz @ +6.20 dB/oct
70 -	110 Hz @ 0.04 (g rms) <sup>2</sup> /Hz
110 -	140 Hz @ -17.30 dB/oct
140 -	150 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
150 -	230 Hz @ +19.07 dB/oct
230 -	510 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
510 -	580 Hz @ -7.26 dB/oct
580 -	870 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
870 -	910 Hz @ -52.80 dB/oct
910 -	930 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
930 -	1200 Hz @ +24.56 dB/oct
1200 -	1230 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
1230 -	1260 Hz @ -114.46 dB/oct
1260 -	1380 Hz @ 0.16 (g rms) <sup>2</sup> /Hz
1380 -	1440 Hz @ +64.81 dB/oct
1440 -	1480 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
1480 -	1510 Hz @ -137.45 dB/oct
1510 -	1600 Hz @ 0.16 (g rms) <sup>2</sup> /Hz
1600 -	1660 Hz @ +110.76 dB/oct
1660 -	2000 Hz @ 0.62 (g rms) <sup>2</sup> /Hz

Random composite reference level = 21.60 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.4 g rms at 500 Hz, 6.9 g rms at 600 Hz, 1.6 g rms at 1000 Hz and 6.7 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 6.9 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 6.7 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level - 23.82 g rms

(Zone N)

Radial direction (engine Y axis)

Steady-state random vibration amplitudes-R4:

20 -	60 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
60 -	90 Hz @ +6.80 dB/oct
90 -	120 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
120 -	160 Hz @ +5.55 dB/oct
160 -	180 Hz @ 0.085 (g rms) <sup>2</sup> /Hz
180 -	190 Hz @ -72.78 dB/oct
190 -	220 Hz @ 0.023 (g rms) <sup>2</sup> /Hz
220 -	400 Hz @ +10.63 dB/oct
400 -	610 Hz @ 0.19 (g rms) <sup>2</sup> /Hz
610 -	640 Hz @ -54.24 dB/oct
640 -	790 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
790 -	840 Hz @ +36.97 dB/oct
840 -	920 Hz @ 0.17 (g rms) <sup>2</sup> /Hz
920 -	960 Hz @ -73.66 dB/oct
960 -	1040 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
1040 -	1120 Hz @ +20.75 dB/oct
1120 -	1200 Hz @ 0.1 (g rms) <sup>2</sup> /Hz
1200 -	1330 Hz @ -34.28 dB/oct
1330 -	1410 Hz @ 0.031 (g rms) <sup>2</sup> /Hz
1410 -	1480 Hz @ +78.69 dB/oct
1480 -	1650 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
1650 -	1780 Hz @ +30.97 dB/oct
1780 -	2000 Hz @ 0.24 (g rms) <sup>2</sup> /Hz

Random composite reference level = 15.19 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.3 g rms at 500 Hz, 6.2 g rms at 600 Hz, 1.2 g rms at 1000 Hz and 4.4 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 6.2 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 4.4 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 17.18 g rms

(Zone N)

Tangential direction (engine Z axis)

Steady-state random vibration amplitudes-R4:

20 -	50 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
50 -	60 Hz @ +24.83 dB/oct
60 -	70 Hz @ 0.045 (g rms) <sup>2</sup> /Hz
70 -	80 Hz @ -33.91 dB/oct
80 -	90 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
90 -	210 Hz @ +5.72 dB/oct
210 -	310 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
310 -	320 Hz @ -114.16 dB/oct
320 -	370 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
370 -	430 Hz @ +51.89 dB/oct
430 -	650 Hz @ 0.2 (g rms) <sup>2</sup> /Hz
650 -	700 Hz @ -56.31 dB/oct
700 -	870 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
870 -	980 Hz @ +54.99 dB/oct
980 -	1120 Hz @ 0.44 (g rms) <sup>2</sup> /Hz
1120 -	1270 Hz @ -52.09 dB/oct
1270 -	1550 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
1550 -	1820 Hz @ +38.02 dB/oct
1820 -	2000 Hz @ 0.38 (g rms) <sup>2</sup> /Hz

Random composite reference level = 17.56 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwell of 4.4 g rms at 600 Hz for 6.5 hr.

Sinusoidal sweep of 4.4 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min for 1.0 hr.

Total composite level = 18.10 g rms

(Zone N-1)

#### 4.5.14 1 SSME Vibration Criteria Zone N-1

This zone includes the fuel preburner oxidizer valve (FPOV) actuator neck.  
Vibration amplitudes are as follows:

##### Parallel to valve flow direction (component X axis)

##### Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.011 (g rms) <sup>2</sup> /Hz
20 -	150 Hz @ +2.96 dB/oct
150 -	240 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
240 -	325 Hz @ +26.88 dB/oct
325 -	375 Hz @ 1.2 (g rms) <sup>2</sup> /Hz
375 -	505 Hz @ -27.39 dB/oct
505 -	700 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
700 -	900 Hz @ -3.45 dB/oct
900 -	2000 Hz @ 0.06 (g rms) <sup>2</sup> /Hz

Random composite reference level = 16.02 g rms

##### Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.8 g rms at 600 Hz, 0.8 g rms at 1000 Hz and 9.0 g rms at 2000 Hz for 6.<sup>5</sup> hr.

Sinusoidal sweeps of 2.8 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 9.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.60 g rms

(Zone N-1)

Perpendicular to valve flow and perpendicular to the actuator shaft  
direction (component Y axis)

Steady-state random vibrational amplitude-R4:

	20 Hz @ 0.011 (g rms) <sup>2</sup> /Hz
20 -	70 Hz @ +5.93 dB/oct
70 -	120 Hz @ 0.13 (g rms) <sup>2</sup> /Hz
120 -	190 Hz @ -4.06 dB/oct
190 -	400 Hz @ 0.07 (g rms) <sup>2</sup> /Hz
400 -	600 Hz @ -2.5 dB/oct
600 -	1180 Hz @ 0.05 (g rms) <sup>2</sup> /Hz
1180 -	1220 Hz @ +48.97 dB/oct
1220 -	1660 Hz @ 0.086 (g rms) <sup>2</sup> /Hz
1660 -	2000 Hz @ -8.77 dB/oct
	2000 Hz @ 0.05 (g rms) <sup>2</sup> /Hz

Random composite reference level = 11.60 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.7 g rms at 500 Hz, 6.7 g rms at 600 Hz, 1.1 g rms at 1000 Hz, and 3.7 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 6.7 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min, and 3.7 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 14.04 g rms

(Zone N-1)

Parallel to the actuator shaft direction (component Z axis)

Steady-state random vibration amplitude-R4:

20 - 90 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
90 - 150 Hz @ +3.01 dB/oct  
150 - 300 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
300 - 500 Hz @ -2.11 dB/oct  
500 - 1000 Hz @  $0.035 (g \text{ rms})^2/\text{Hz}$   
1000 - 1500 Hz @ +4.0 dB/oct  
1500 - 2000 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 9.56 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.7 g rms at 500 Hz, 3.9 g rms at 600 Hz, and 2.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.9 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 2.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 10.65 g rms



(Zone O)

#### 4.5.15 SSME Vibration Criteria Zone C

This zone includes the oxidizer preburner oxidizer valve (OPOV). The dynamic environments are as follows:

Transient shock spectrum-R1: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

25 Hz @ 25.0 g peak  
250 Hz @ 30.0 g peak  
600 Hz @ 80.0 g peak  
1500 Hz @ 90.0 g peak  
2000 Hz @ 190 g peak

Axial direction (engine X axis)

Steady-state random vibration amplitudes-R4:

20 - 50 Hz @  $0.023 (g \text{ rms})^2/\text{Hz}$   
50 - 70 Hz @ +25.55 dB/oct  
70 - 90 Hz @  $0.4 (g \text{ rms})^2/\text{Hz}$   
90 - 120 Hz @ -29.88 dB/oct  
120 - 140 Hz @  $0.023 (g \text{ rms})^2/\text{Hz}$   
140 - 260 Hz @ +12.49 dB/oct  
260 - 320 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
320 - 350 Hz @ -44.4 dB/oct  
350 - 400 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
400 - 430 Hz @ +66.99 dB/oct  
430 - 570 Hz @  $0.4 (g \text{ rms})^2/\text{Hz}$   
570 - 650 Hz @ -15.89 dB/oct  
650 - 1230 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
1230 - 1240 Hz @ +186.17 dB/oct  
1240 - 1300 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
1300 - 1320 Hz @ -38.74 dB/oct  
1320 - 2000 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 20.54 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 11.3 g rms at 500 Hz, 1.4 g rms at 1000 Hz and 6.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 11.3 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 6.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 24.24 g rms

(Zone O)

Radial direction (engine Y axis)

Steady-state random vibration amplitudes-R4:

20 - 50 Hz @  $0.018 (g \text{ rms})^2/\text{Hz}$   
50 - 90 Hz @ +20.14 dB/oct  
90 - 120 Hz @  $0.9 (g \text{ rms})^2/\text{Hz}$   
120 - 160 Hz @ -18.07 dB/oct  
160 - 210 Hz @  $0.16 (g \text{ rms})^2/\text{Hz}$   
210 - 220 Hz @ -30.41 dB/oct  
220 - 260 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
260 - 300 Hz @ -14.58 dB/oct  
300 - 350 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
350 - 400 Hz @ +15.63 dB/oct  
400 - 670 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
670 - 680 Hz @ +82.39 dB/oct  
680 - 710 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
710 - 730 Hz @ -43.94 dB/oct  
730 - 950 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
950 - 1100 Hz @ -14.23 dB/oct  
1100 - 1450 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
1450 - 2000 Hz @ +19.47 dB/oct  
2000 Hz @  $0.4 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 16.11 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 11.3 g rms at 500 Hz, 1.3 g rms at 600 Hz, 1.6 g rms at 1000 Hz and 2.1 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 11.3 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 2.1 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 19.90 g rms

(Zone O)

Tangential direction (engine Z axis)

Steady-state random vibration amplitudes-R4:

20 - 40 Hz @  $0.012 (g \text{ rms})^2/\text{Hz}$   
40 - 50 Hz @ +13.65 dB/oct  
50 - 60 Hz @  $0.033 (g \text{ rms})^2/\text{Hz}$   
60 - 90 Hz @ -7.51 dB/oct  
90 - 160 Hz @  $0.012 (g \text{ rms})^2/\text{Hz}$   
160 - 230 Hz @ +16.71 dB/oct  
230 - 280 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$   
280 - 500 Hz @ -11.41 dB/oct  
500 - 600 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
600 - 1450 Hz @ +7.50 dB/oct  
1450 - 2000 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 10.15 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 0.6 g rms at 500 Hz, 1.3 g rms at 600 Hz, 1.2 g rms at 1000 Hz and 4.3 g rms at 2000 Hz for 6.5 hr

Sinusoidal sweeps of 1.3 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 4.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 11.18 g rms

#### 4.5.15.1 SSME Vibration Criteria Zone O-1

This zone includes the oxidizer preburner oxidizer valve (OPOV) actuator neck.  
Vibration amplitudes are as follows:

Transient shock spectrum-R2: (engine axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
250 Hz @ 80.0 g peak  
2000 Hz @ 100 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
100 Hz @ 50.0 g peak  
2000 Hz @ 100 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
100 Hz @ 20.0 g peak  
2000 Hz @ 200 g peak

##### Parallel to the valve flow direction (component X axis)

Steady-state random vibration amplitudes-R4:

20 Hz @  $0.011 (g \text{ rms})^2/\text{Hz}$   
20 - 150 Hz @ +2.96 dB/oct  
150 - 240 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$   
240 - 325 Hz @ +26.88 dB/oct  
325 - 375 Hz @  $1.2 (g \text{ rms})^2/\text{Hz}$   
375 - 505 Hz @ -27.39 dB/oct  
505 - 700 Hz @  $0.08 (g \text{ rms})^2/\text{Hz}$   
700 - 900 Hz @ -3.45 dB/oct  
900 - 2000 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 16.01 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.1 g rms at 500 Hz, 1.0 g rms at 1000 Hz, 0.9 g rms at 1500 Hz and 9.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 2.1 g rms from 450 Hz to 1040 Hz to 450 Hz at 340 Hz/min and 9.0 g rms from 1050 Hz to 2000 Hz to 1050 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 18.53 g rms

(Zone O-1)

Perpendicular to the valve flow and perpendicular to the actuator shaft  
direction (component Y axis)

Steady-state random vibration amplitudes-R4:

20 Hz @  $0.011 (g \text{ rms})^2/\text{Hz}$   
20 - 70 Hz @ +5.93 dB/oct  
70 - 120 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
120 - 190 Hz @ -4.06 dB/oct  
190 - 400 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
400 - 600 Hz @ 2.5 dB/oct  
600 - 2000 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 10.61 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3 g rms at 500 Hz, 1.7 g rms at 600 Hz, 2.1 g rms at 1000 Hz, and 4.1 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweep of 2.1 g rms from 350 Hz to 1040 to 350 Hz at 340 Hz/min and 4.1 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 11.76 g rms

Parallel to the actuator shaft direction (component Z axis)

Steady-state random vibration amplitudes-R4:

20 Hz @  $0.01 (g \text{ rms})^2/\text{Hz}$   
20 - 150 Hz @ +2.4 dB/oct  
150 - 300 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
300 - 500 Hz @ -2.11 dB/oct  
500 - 1000 Hz @  $0.035 (g \text{ rms})^2/\text{Hz}$   
1000 - 1500 Hz @ +4.0 dB/oct  
1500 - 2000 Hz @  $0.06 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 9.54 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.0 g rms at 600 Hz, 1.3 g rms at 1500 Hz, and 3.8 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 1.0 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 3.8 g rms from 1050 Hz to 2000 Hz to 1050 Hz at 600 Hz/min for 1.0 hr

Total composite level = 10.40 g rms

4.5.16 SSME Vibration Criteria Zone P

This zone includes the oxidizer bleed valve (OBV) and the fuel bleed valve (FBV).  
The dynamic environments are as follows:

Transient shock spectrum-R4: (component axes)

X axis (Q=10) 120 pulses

20 Hz @ 7.0 g peak  
80 Hz @ 30.0 g peak  
200 Hz @ 40.0 g peak  
400 Hz @ 300 g peak  
800 Hz @ 150 g peak  
2000 Hz @ 200 g peak

Y axis (Q=10) 120 pulses

20 Hz @ 3.0 g peak  
80 Hz @ 20.0 g peak  
170 Hz @ 120 g peak  
300 Hz @ 100 g peak  
400 Hz @ 200 g peak  
2000 Hz @ 260 g peak

Z axis (Q=10) 120 pulses

20 Hz @ 3.0 g peak  
100 Hz @ 25.0 g peak  
350 Hz @ 200 g peak  
1000 Hz @ 150 g peak  
2000 Hz @ 200 g peak

(Zone P)

Outlet flow axis (component X axis)

Steady-state random vibration amplitudes-R4:

20 - 125 Hz @  $0.11 (g \text{ rms})^2/\text{Hz}$   
125 - 135 Hz @ +36.6 dB/oct  
135 - 330 Hz @  $0.27 (g \text{ rms})^2/\text{Hz}$   
330 - 380 Hz @ -18.9 dB/oct  
380 - 670 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
670 - 790 Hz @ +30.5 dB/oct  
790 - 930 Hz @  $0.57 (g \text{ rms})^2/\text{Hz}$   
930 - 1090 Hz @ -13.7 dB/oct  
1090 - 2090 Hz @  $0.28 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 23.33 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 300 Hz at 4.0 g rms and 2000 Hz at 11.0 g rms for 6.5 hr.

Sinusoidal sweeps of 4.0 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 11.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 26.07 g rms

Vertical to actuator axis (component Y axis)

Steady-state random vibration amplitudes-R4:

20	-	125 Hz @ 0.08 (g rms) <sup>2</sup> /Hz
125	-	170 Hz @ +30.6 dB/oct
170	-	190 Hz @ 0.4 (g rms) <sup>2</sup> /Hz
190	-	225 Hz @ -24.3 dB/oct
225	-	320 Hz @ 0.11 (g rms) <sup>2</sup> /Hz
320	-	400 Hz @ +22.6 dB/oct
400	-	450 Hz @ 0.6 (g rms) <sup>2</sup> /Hz
450	-	490 Hz @ -39.6 dB/oct
490	-	640 Hz @ 0.19 (g rms) <sup>2</sup> /Hz
640	-	700 Hz @ +26.2 dB/oct
700	-	835 Hz @ 0.46 (g rms) <sup>2</sup> /Hz
835	-	910 Hz @ -44.7 dB/oct
910	-	950 Hz @ 0.14 (g rms) <sup>2</sup> /Hz
950	-	1200 Hz @ +21.3 dB/oct
1200	-	1700 Hz @ 0.73 (g rms) <sup>2</sup> /Hz
1700	-	1800 Hz @ -38.7 dB/oct
1800	-	2000 Hz @ 0.22 (g rms) <sup>2</sup> /Hz

Random composite reference level = 28.10 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 500 Hz at 2.9 g rms, 600 Hz at 13.5 g rms, 1500 Hz at 8.4 g rms and 2000 Hz at 7.25 g rms for 6.5 hr.

Sinusoidal sweeps of 13.5 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 7.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 33.22 g rms



(Zone P)

Radial to actuator axis (component Z axis)

Steady-state random vibration amplitudes-R4:

20 - 130 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
130 - 380 Hz @ +8.4 dB/oct  
380 - 450 Hz @  $2.0 (g \text{ rms})^2/\text{Hz}$   
450 - 510 Hz @ -66.9 dB/oct  
510 - 640 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
640 - 710 Hz @ +16.5 dB/oct  
710 - 800 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
800 - 960 Hz @ -21.2 dB/oct  
960 - 1170 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$   
1170 - 1290 Hz @ +63.0 dB/oct  
1290 - 1360 Hz @  $0.7 (g \text{ rms})^2/\text{Hz}$   
1360 - 1440 Hz @ -37.7 dB/oct  
1440 - 1760 Hz @  $0.36 (g \text{ rms})^2/\text{Hz}$   
1760 - 1820 Hz @ -96.5 dB/oct  
1820 - 2000 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 27.91 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 600 Hz at 11.8 g rms, 1200 Hz at 2.0 g rms, 1500 Hz at 6.0 g rms and 2000 Hz at 6.3 g rms for 6.5 hr.

Sinusoidal sweeps of 11.8 g rms from 450 Hz to 620 Hz to 450 Hz at 170 Hz/min and 6.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 31.53 g rms

(Zone P-1)

#### 4.5.16.1 SSME Vibration Criteria Zone P-1

This zone includes the fuel bleed duct flex joint. Vibration amplitudes are as follows:

Transient shock spectrum-R4: (component axes)

##### X axis (Q=10) 120 pulses

10 Hz @ 10.0 g peak  
50 Hz @ 26.0 g peak  
100 Hz @ 40.0 g peak  
250 Hz @ 214 g peak  
500 Hz @ 100 g peak  
1000 Hz @ 100 g peak  
2000 Hz @ 135 g peak

##### Y axis (Q=10) 120 pulses

10 Hz @ 10.0 g peak  
50 Hz @ 30.0 g peak  
100 Hz @ 36.0 g peak  
250 Hz @ 210 g peak  
500 Hz @ 90.0 g peak  
1000 Hz @ 180 g peak  
2000 Hz @ 200 g peak

##### Z axis (Q=10) 120 pulses

10 Hz @ 6.0 g peak  
50 Hz @ 18.0 g peak  
100 Hz @ 35.0 g peak  
250 Hz @ 148 g peak  
500 Hz @ 83.0 g peak  
1000 Hz @ 240 g peak  
2000 Hz @ 135 g peak

(Zone P-1)

Radial direction (component X axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.0014 (g rms) <sup>2</sup> /Hz
20 -	50 Hz @ +4.25 dB/oct
50 -	120 Hz @ 0.0051 (g rms) <sup>2</sup> /Hz
120 -	130 Hz @ +6.73 dB/oct
130 -	140 Hz @ 0.0061 (g rms) <sup>2</sup> /Hz
140 -	170 Hz @ +6.03 dB/oct
170 -	310 Hz @ 0.009 (g rms) <sup>2</sup> /Hz
310 -	400 Hz @ +20.45 dB/oct
400 -	550 Hz @ 0.051 (g rms) <sup>2</sup> /Hz
550 -	700 Hz @ -20.34 dB/oct
	700 Hz @ 0.01 (g rms) <sup>2</sup> /Hz
700 -	780 Hz @ +39.92 dB/oct
780 -	890 Hz @ 0.042 (g rms) <sup>2</sup> /Hz
890 -	940 Hz @ -46.67 dB/oct
	940 Hz @ 0.018 (g rms) <sup>2</sup> /Hz
940 -	1400 Hz @ +8.71 dB/oct
1400 -	2000 Hz @ 0.057 (g rms) <sup>2</sup> /Hz

Random composite reference level = 8.59 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 500 Hz at 1.0 g rms, 600 Hz at 2.05 g rms and 2000 Hz at 3.56 g rms for 6.5 hr.

Sinusoidal sweeps of 2.05 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 3.56 g rms, from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 9.57 g rms

Axial direction (component Y axis)

## Steady-state random vibration amplitudes-R4:

20 Hz @ 0.0017 (g rms)<sup>2</sup>/Hz  
 20 - 50 Hz @ +4.25 dB/oct  
 50 - 60 Hz @ 0.0062 (g rms)<sup>2</sup>/Hz  
 60 - 80 Hz @ -6.92 dB/oct  
 80 - 90 Hz @ 0.0032 (g rms)<sup>2</sup>/Hz  
 90 - 130 Hz @ +17.76 dB/oct  
 130 - 180 Hz @ 0.028 (g rms)<sup>2</sup>/Hz  
 180 - 210 Hz @ -36.14 dB/oct  
 210 - 250 Hz @ 0.0044 (g rms)<sup>2</sup>/Hz  
 250 - 260 Hz @ +58.26 dB/oct  
 260 - 300 Hz @ 0.0094 (g rms)<sup>2</sup>/Hz  
 300 - 350 Hz @ -22.30 dB/oct  
 350 - 370 Hz @ 0.003 (g rms)<sup>2</sup>/Hz  
 370 - 400 Hz @ +64.64 dB/oct  
 400 - 690 Hz @ 0.016 (g rms)<sup>2</sup>/Hz  
 690 - 720 Hz @ +113.84 dB/oct  
 720 - 740 Hz @ 0.08 (g rms)<sup>2</sup>/Hz  
 740 - 760 Hz @ -72.74 dB/oct  
 760 - 860 Hz @ 0.042 (g rms)<sup>2</sup>/Hz  
 860 - 880 Hz @ +171.63 dB/oct  
 880 - 910 Hz @ 0.284 (g rms)<sup>2</sup>/Hz  
 910 - 990 Hz @ +18.00 dB/oct  
 990 - 1010 Hz @ 0.47 (g rms)<sup>2</sup>/Hz  
 1010 - 1070 Hz @ -86.22 dB/oct  
 1070 - 1100 Hz @ 0.09 (g rms)<sup>2</sup>/Hz  
 1100 - 1380 Hz @ -10.44 dB/oct  
 1380 - 1490 Hz @ 0.041 (g rms)<sup>2</sup>/Hz  
 1490 - 1510 Hz @ -227.02 dB/oct  
 1510 Hz @ 0.015 (g rms)<sup>2</sup>/Hz  
 1510 - 1700 Hz @ +28.46 dB/oct  
 1700 - 2000 Hz @ 0.046 (g rms)<sup>2</sup>/Hz

Random composite reference level = 11.21 g rms

## Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 500 Hz at 0.8 g rms, 600 Hz at 1.76 g rms, 1200 Hz at 1.76 g rms and 2000 Hz at 0.8 g rms for 6.5 hr.

Sinusoidal sweeps of 1.76 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 0.8 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 11.54 g rms

(Zone P-1)

Tangential direction (component Z axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ 0.002 (g rms) <sup>2</sup> /Hz
20 -	50 Hz @ +3.01 dB/oct
50 -	90 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
90 -	110 Hz @ +14.33 dB/oct
110 -	140 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
140 -	150 Hz @ +89.02 dB/oct
	150 Hz @ 1.1 (g rms) <sup>2</sup> /Hz
150 -	170 Hz @ -49.07 dB/oct
170 -	190 Hz @ 0.013 (g rms) <sup>2</sup> /Hz
190 -	200 Hz @ -56.08 dB/oct
200 -	230 Hz @ 0.005 (g rms) <sup>2</sup> /Hz
230 -	240 Hz @ +90.60 dB/oct
240 -	300 Hz @ 0.018 (g rms) <sup>2</sup> /Hz
300 -	370 Hz @ +17.28 dB/oct
370 -	410 Hz @ 0.06 (g rms) <sup>2</sup> /Hz
410 -	420 Hz @ -86.59 dB/oct
420 -	490 Hz @ 0.03 (g rms) <sup>2</sup> /Hz
490 -	520 Hz @ -31.84 dB/oct
520 -	540 Hz @ 0.016 (g rms) <sup>2</sup> /Hz
540 -	610 Hz @ +38.15 dB/oct
610 -	790 Hz @ 0.075 (g rms) <sup>2</sup> /Hz
790 -	840 Hz @ -15.21 dB/oct
840 -	970 Hz @ 0.055 (g rms) <sup>2</sup> /Hz
970 -	1060 Hz @ -34.32 dB/oct
1060 -	1220 Hz @ 0.02 (g rms) <sup>2</sup> /Hz
1220 -	1240 Hz @ -53.26 dB/oct
1240 -	1450 Hz @ 0.015 (g rms) <sup>2</sup> /Hz
1450 -	1540 Hz @ +77.01 dB/oct
1540 -	1600 Hz @ 0.07 (g rms) <sup>2</sup> /Hz
1600 -	1690 Hz @ -23.10 dB/oct
1690 -	2000 Hz @ 0.046 (g rms) <sup>2</sup> /Hz

Random composite reference level = 8.69 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 500 Hz at 0.8 g rms, 600 Hz at 1.77 g rms, 1000 Hz at 1.2 g rms and 2000 Hz at 1.12 g rms for 6.5 hr.

Sinusoidal sweeps of 1.77 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 1.12 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 9.05 g rms

#### 4.5.17 SSME Vibration Criteria Zone Q

This zone includes the vehicle attach points for customer connect lines. Vibration amplitudes are as follows:

##### Transient vibration amplitudes-R1:

##### X, Y and Z axes (engine axes)

5 to 13 Hz @ 0.38 in. DA  
13 - 54 Hz @ 3.3 g peak  
54 - 140 Hz @ 0.022 in. DA  
140 - 2000 Hz @ 22.0 g peak

##### Flight direction (engine X axis)

##### Steady-state random vibration amplitudes-R2:

20 - 170 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
170 - 300 Hz @ +15.0 dB/oct  
300 - 550 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
550 - 750 Hz @ -6.0 dB/oct  
750 - 1300 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1300 - 2000 Hz @ +12.0 dB/oct

Total composite level = 23.0 g rms

##### Lateral direction (engine Y and Z axis)

##### Steady-state random vibration amplitudes-R2:

20 - 50 Hz @  $0.006 (g \text{ rms})^2/\text{Hz}$   
50 - 170 Hz @ 2.84 dB/oct  
170 Hz @  $0.019 (g \text{ rms})^2/\text{Hz}$   
170 - 300 Hz @ +14.97 dB/oct  
300 - 550 Hz @  $0.32 (g \text{ rms})^2/\text{Hz}$   
550 - 750 Hz @ -7.35 dB/oct  
750 - 1300 Hz @  $0.15 (g \text{ rms})^2/\text{Hz}$   
1300 - 2000 Hz @ +12.04 dB/oct  
2000 Hz @  $0.84 (g \text{ rms})^2/\text{Hz}$

Total composite level = 22.82 g rms

4.5.18 SSME Vibration Criteria Zone R

This zone includes the pressure sensor. Vibration amplitudes are as follows:

Transient shock spectrum-R2:

X, Y and Z axes (engine axes)

10 Hz @ 20.0 g peak  
 20 Hz @ 80.0 g peak  
 36 Hz @ 80.0 g peak  
 44 Hz @ 120 g peak  
 170 Hz @ 120 g peak  
 315 Hz @ 400 g peak  
 2000 Hz @ 400 g peak

X, Y and Z axes (engine axes)

Steady-state random vibration amplitudes-R4:

20 - 80 Hz @ 0.1 (g rms)<sup>2</sup>/Hz  
 80 - 90 Hz @ +6.7 dB/oct  
 90 - 120 Hz @ 0.13 (g rms)<sup>2</sup>/Hz  
 120 - 130 Hz @ +42.26 dB/oct  
 130 - 150 Hz @ 0.4 (g rms)<sup>2</sup>/Hz  
 150 - 160 Hz @ -42.74 dB/oct  
 160 - 170 Hz @ 0.16 (g rms)<sup>2</sup>/Hz  
 170 - 180 Hz @ +55.61 dB/oct  
 180 - 200 Hz @ 0.46 (g rms)<sup>2</sup>/Hz  
 200 - 210 Hz @ -51.39 dB/oct  
 210 - 220 Hz @ 0.2 (g rms)<sup>2</sup>/Hz  
 220 - 380 Hz @ +7.83 dB/oct  
 380 - 420 Hz @ 0.83 (g rms)<sup>2</sup>/Hz  
 420 - 440 Hz @ -21.0 dB/oct  
 440 - 720 Hz @ 0.6 (g rms)<sup>2</sup>/Hz  
 720 - 820 Hz @ +11.82 dB/oct  
 820 - 1020 Hz @ 1.0 (g rms)<sup>2</sup>/Hz  
 1020 - 1060 Hz @ +112.3 dB/oct  
 1060 - 1120 Hz @ 4.2 (g rms)<sup>2</sup>/Hz  
 1120 - 1150 Hz @ -84.5 dB/oct  
 1150 - 1170 Hz @ 2.0 (g rms)<sup>2</sup>/Hz  
 1170 - 1240 Hz @ +83.37 dB/oct  
 1240 - 1290 Hz @ 10.0 (g rms)<sup>2</sup>/Hz  
 1290 - 1310 Hz @ -135.63 dB/oct  
 1310 - 1320 Hz @ 5.0 (g rms)<sup>2</sup>/Hz  
 1330 - 1340 Hz @ +73.27 dB/oct  
 1340 - 1430 Hz @ 6.0 (g rms)<sup>2</sup>/Hz  
 1430 - 1530 Hz @ -48.93 dB/oct

(Zone R)

1530 - 1560 Hz @  $2.0 \text{ (g rms)}^2/\text{Hz}$   
1560 - 1630 Hz @  $+62.83 \text{ dB/oct}$   
1630 - 1750 Hz @  $5.0 \text{ (g rms)}^2/\text{Hz}$   
1750 - 1770 Hz @  $-256.32 \text{ dB/oct}$   
1770 - 1920 Hz @  $1.9 \text{ (g rms)}^2/\text{Hz}$   
1920 - 1960 Hz @  $+227.07 \text{ dB/oct}$   
1960 - 2000 Hz @  $9.0 \text{ (g rms)}^2/\text{Hz}$

Random composite reference level = 70.115 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.9 g rms at 270 Hz, 9.4 g rms at 500 Hz, 9.0 g rms at 600 Hz, 10.2 g rms at 1000 Hz, 9.6 g rms at 1620 Hz, and 19.6 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 1.9 g rms from 200 Hz to 270 Hz to 200 Hz at 70 Hz/min, and 19.6 g rms from 350 Hz to 2000 Hz to 350 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 75.30 g rms



(Zone S)

4.5.19 SSME Vibration Criteria Zone S

This zone includes the anti-flood valve (AFV) Vibration amplitudes are as follows:

Transient shock spectrum R2: (component axes)

X axis (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
125 Hz @ 200 g peak  
250 Hz @ 1050 g peak  
400 Hz @ 450 g peak  
2000 Hz @ 3000 g peak

Y axis (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
125 Hz @ 130 g peak  
250 Hz @ 600 g peak  
400 Hz @ 600 g peak  
600 Hz @ 350 g peak  
2000 Hz @ 1500 g peak

Z axis (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
125 Hz @ 80.0 g peak  
250 Hz @ 700 g peak  
800 Hz @ 200 g peak  
1500 Hz @ 650 g peak  
2000 Hz @ 650 g peak

(Zone S)

X axis (component axis)

Steady-state random vibration amplitudes-R4:

20 - 150 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
150 - 200 Hz @ +10.90 dB/oct  
200 - 240 Hz @  $0.85 (g \text{ rms})^2/\text{Hz}$   
240 - 300 Hz @ -11.97 dB/oct  
300 - 650 Hz @  $0.35 (g \text{ rms})^2/\text{Hz}$   
650 - 750 Hz @ +2.81 dB/oct  
750 - 800 Hz @  $0.4 (g \text{ rms})^2/\text{Hz}$   
800 - 850 Hz @ -27.48 dB/oct  
850 - 960 Hz @  $0.23 (g \text{ rms})^2/\text{Hz}$   
960 - 1020 Hz @ +67.74 dB/oct  
1020 - 1150 Hz @  $0.9 (g \text{ rms})^2/\text{Hz}$   
1150 - 1200 Hz @ -52.24 dB/oct  
1200 - 1450 Hz @  $0.43 (g \text{ rms})^2/\text{Hz}$   
1450 - 1510 Hz @ +114.12 dB/oct  
1510 - 1560 Hz @  $2.0 (g \text{ rms})^2/\text{Hz}$   
1560 - 1680 Hz @ -32.44 dB/oct  
1680 - 1790 Hz @  $0.9 (g \text{ rms})^2/\text{Hz}$   
1790 - 1850 Hz @ +81.61 dB/oct  
1850 - 2000 Hz @  $2.2 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 38.50 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 11.5 g rms at 500 Hz, 4.5 g rms at 600, 5.7 g rms at 1000 Hz, and 10.3 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 11.5 g rms from 350 Hz to 500 Hz to 350 Hz at 150 Hz/min and 10.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 42.11 g rms

(Zone S)

Y axis (component axis)

Steady-state random vibration amplitudes-R4:

20	-	80 Hz @ 0.15 (g rms) <sup>2</sup> /Hz
80	-	280 Hz @ +5.00 dB/oct
280	-	360 Hz @ 1.2 (g rms) <sup>2</sup> /Hz
360	-	420 Hz @ -24.63 dB/oct
420	-	550 Hz @ 0.34 (g rms) <sup>2</sup> /Hz
550	-	620 Hz @ +21.50 dB/oct
620	-	640 Hz @ 0.8 (g rms) <sup>2</sup> /Hz
640	-	660 Hz @ -28.14 dB/oct
660	-	800 Hz @ 0.6 (g rms) <sup>2</sup> /Hz
800	-	850 Hz @ -34.42 dB/oct
850	-	900 Hz @ 0.3 (g rms) <sup>2</sup> /Hz
900	-	980 Hz @ +67.06 dB/oct
980	-	1050 Hz @ 2.0 (g rms) <sup>2</sup> /Hz
1050	-	1150 Hz @ -45.87 dB/oct
1150	-	1250 Hz @ 0.5 (g rms) <sup>2</sup> /Hz
1250	-	1300 Hz @ +98.32 dB/oct
1300	-	1380 Hz @ 1.8 (g rms) <sup>2</sup> /Hz
1380	-	1420 Hz @ -85.43 dB/oct
1420	-	1630 Hz @ 0.8 (g rms) <sup>2</sup> /Hz
1630	-	1700 Hz @ +72.42 dB/oct
1700	-	1880 Hz @ 2.2 (g rms) <sup>2</sup> /Hz
1880	-	2000 Hz @ +39.94 dB/oct
		2000 Hz @ 5.0 (g rms) <sup>2</sup> /Hz

Random composite reference level = 46.75 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 7.4 g rms at 500 Hz, 6.0 g rms at 600 Hz, 8.4 g rms at 1000 Hz, 4.6 g rms at 1500 Hz and 60.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 8.4 g rms from 350 Hz to 1040 Hz to 350 Hz at 340 Hz/min and 60.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 77.72 g rms

(4)  
(Zone S)

Z axis (component axis)

Steady-state random vibration amplitudes-R4:

	20	at	$0.11 (g \text{ rms})^2/\text{Hz}$
20 -	95	Hz @	$+2.49 \text{ dB/oct}$
95 -	170	Hz @	$0.4 (g \text{ rms})^2/\text{Hz}$
170 -	190	Hz @	$+40.71 \text{ dB/oct}$
190 -	200	Hz @	$1.8 (g \text{ rms})^2/\text{Hz}$
200 -	210	Hz @	$-87.79 \text{ dB/oct}$
210 -	240	Hz @	$6.42 (g \text{ rms})^2/\text{Hz}$
240 -	260	Hz @	$-9.07 \text{ dB/oct}$
260 -	400	Hz @	$0.33 (g \text{ rms})^2/\text{Hz}$
400 -	430	Hz @	$+17.30 \text{ dB/oct}$
430 -	490	Hz @	$0.5 (g \text{ rms})^2/\text{Hz}$
490 -	530	Hz @	$-35.15 \text{ dB/oct}$
530 -	570	Hz @	$0.2 (g \text{ rms})^2/\text{Hz}$
570 -	620	Hz @	$+76.62 \text{ dB/oct}$
620 -	700	Hz @	$1.7 (g \text{ rms})^2/\text{Hz}$
700 -	900	Hz @	$-20.78 \text{ dB/oct}$
900 -	970	Hz @	$0.3 (g \text{ rms})^2/\text{Hz}$
970 -	1000	Hz @	$-217.15 \text{ dB/oct}$
1000 -	1030	Hz @	$2.7 (g \text{ rms})^2/\text{Hz}$
1030 -	1090	Hz @	$-116.83 \text{ dB/oct}$
1090 -	1200	Hz @	$0.3 (g \text{ rms})^2/\text{Hz}$
1200 -	1270	Hz @	$+105.79 \text{ dB/oct}$
1270 -	1780	Hz @	$2.2 (g \text{ rms})^2/\text{Hz}$
1780 -	1800	Hz @	$+34.44 \text{ dB/oct}$
1800 -	2000	Hz @	$2.5 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 50.22 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 7.1 g rms at 500 Hz, 4.7 g rms at 600 Hz and 42.3 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 7.1 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 42.3 g rms at 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 66.21 g rms

#### 4.5.20 SSME Vibration Criteria Zone T

This zone includes the check valve. Vibration amplitudes are as follows:

Transient shock spectrum-R2: (engine axes)

X, Y and Z axes (Q=1G) 120 pulses

10 Hz @ 1.0 g peak  
30 Hz @ 40.0 g peak  
800 Hz @ 60.0 g peak  
2000 Hz @ 200 g peak

X, Y, and Z axes

Steady-state random vibration amplitudes-R4:

20 - 175 Hz @  $0.09 (g \text{ rms})^2/\text{Hz}$   
175 - 230 Hz @ +4.0 dB/oct  
230 - 310 Hz @  $0.13 (g \text{ rms})^2/\text{Hz}$   
310 - 400 Hz @ -18.0 dB/oct  
400 - 1500 Hz @  $0.6 (g \text{ rms})^2/\text{Hz}$   
1500 - 1750 Hz @ +21.4 dB/oct  
1750 - 2000 Hz @  $1.8 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 38.0 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 8.0 g rms at 500 Hz, 8.5 g rms at 600 Hz, 3.0 g rms at 1000 Hz, 5.1 g rms at 1200 Hz, and 5.5 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 8.5 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 5.5 g rms from 700 Hz to 2000 Hz to 700 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 40.56 g rms

(Zone U)

#### 4.5.21 SSME Vibration Criteria Zone U

This zone includes the POGO accumulator and recirculation isolation valve (RIV).  
Vibration amplitudes are as follows:

Transient shock spectrum-R2: (component axes)

X, Y and Z axes (Q=10) 120 pulses

20 Hz @ 10.0 g peak  
100 Hz @ 90.0 g peak  
300 Hz @ 80.0 g peak  
1000 Hz @ 1000 g peak  
2000 Hz @ 1000 g peak

X axis (component axis)

Steady-state random vibration amplitudes-R4:

20 - 30 Hz @  $0.02 (g \text{ rms})^2/\text{Hz}$   
30 - 94 Hz @ +4.73 dB/oct  
94 - 120 Hz @  $0.12 (g \text{ rms})^2/\text{Hz}$   
120 - 150 Hz @ -11.81 dB/oct  
150 - 580 Hz @  $0.05 (g \text{ rms})^2/\text{Hz}$   
580 - 620 Hz @ +46.48 dB/oct  
620 - 660 Hz @  $0.14 (g \text{ rms})^2/\text{Hz}$   
660 - 700 Hz @ -35.46 dB/oct  
700 - 820 Hz @  $0.07 (g \text{ rms})^2/\text{Hz}$   
820 - 940 Hz @ +23.14 dB/oct  
940 - 1250 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
1250 - 1340 Hz @ +49.68 dB/oct  
1340 - 1450 Hz @  $0.63 (g \text{ rms})^2/\text{Hz}$   
1450 - 1500 Hz @ -40.34 dB/oct  
1500 - 1730 Hz @  $0.4 (g \text{ rms})^2/\text{Hz}$   
1730 - 1800 Hz @ -27.07 dB/oct  
1800 - 2000 Hz @  $0.28 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 20.74 g rms

Superimposed steady-state sinusoids R4:

Sinusoidal dwells of 9.4 g rms at 500 Hz, 1.3 g rms at 600 Hz, 2.8 g rms at 1000 Hz and 15.9 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 9.4 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 15.9 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 27.94 g rms

(Zone U)

Y axis (component axis)

Steady-state random vibration amplitudes-R4:

	20 Hz @ $0.11 (g \text{ rms})^2/\text{Hz}$
20 -	40 Hz @ -3.42 dB/oct
40 -	60 Hz @ $0.05 (g \text{ rms})^2/\text{Hz}$
60 -	100 Hz @ +4.09 dB/oct
100 -	140 Hz @ $0.1 (g \text{ rms})^2/\text{Hz}$
140 -	160 Hz @ -15.63 dB/oct
160 -	250 Hz @ $0.05 (g \text{ rms})^2/\text{Hz}$
250 -	320 Hz @ +5.73 dB/oct
320 -	340 Hz @ $0.08 (g \text{ rms})^2/\text{Hz}$
340 -	360 Hz @ -15.15 dB/oct
360 -	800 Hz @ $0.06 (g \text{ rms})^2/\text{Hz}$
800 -	870 Hz @ +32.88 dB/oct
870 -	1100 Hz @ $0.15 (g \text{ rms})^2/\text{Hz}$
1100 -	1160 Hz @ +42.95 dB/oct
1160 -	2000 Hz @ $0.32 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 19.60 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 5.9 g rms at 500 Hz, 3.4 g rms at 1000 Hz and 17.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 5.9 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 17.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 26.82 g rms

(Zone U)

Z axis (component axis)

Steady-state random vibration amplitudes-R4:

20 - 30 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
30 - 150 Hz @ +2.25 dB/oct  
150 Hz @  $0.1 (g \text{ rms})^2/\text{Hz}$   
150 - 390 Hz @ +6.67 dB/oct  
390 - 420 Hz @  $0.83 (g \text{ rms})^2/\text{Hz}$   
420 - 480 Hz @ -22.94 dB/oct  
480 - 600 Hz @  $0.3 (g \text{ rms})^2/\text{Hz}$   
600 - 840 Hz @ +10.77 dB/oct  
840 - 1240 Hz @  $1.0 (g \text{ rms})^2/\text{Hz}$   
1240 - 1350 Hz @ +63.46 dB/oct  
1350 - 1430 Hz @  $6.0 (g \text{ rms})^2/\text{Hz}$   
1430 - 1470 Hz @ -119.88 dB/oct  
1470 - 1580 Hz @  $2.0 (g \text{ rms})^2/\text{Hz}$   
1580 - 1650 Hz @ +63.63 dB/oct  
1650 - 1750 Hz @  $5.0 (g \text{ rms})^2/\text{Hz}$   
1750 - 1800 Hz @ -171.98 dB/oct  
1800 - 2000 Hz @  $1.0 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 54.31 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.2 g rms at 500 Hz, 3.2 g rms at 600 Hz, 10.2 g rms at 1000 Hz and 19.6 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.2 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 19.6 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 58.81 g rms



(Zone U-1)

#### 4.5.21.1 SSME Vibration Criteria Zone U-1

This zone includes the helium precharge assembly (HPA) and gaseous oxygen control assembly (GCA). Vibration amplitudes are as follows:

##### X axis (component axis)

##### Steady-state random vibration amplitudes-R4:

20	-	160 Hz	@	0.3 (g rms) <sup>2</sup> /Hz
160		520 Hz	@	-2.56 dB/oct
520	-	690 Hz	@	0.11 (g rms) <sup>2</sup> /Hz
690	-	700 Hz	@	+50.45 dB/oct
700	-	730 Hz	@	0.14 (g rms) <sup>2</sup> /Hz
730	-	740 Hz	@	-123.82 dB/oct
740	-	810 Hz	@	0.08 (g rms) <sup>2</sup> /Hz
810	-	830 Hz	@	+185.63 dB/oct
830	-	1040 Hz	@	0.36 (g rms) <sup>2</sup> /Hz
1040	-	1050 Hz	@	-218.05 dB/oct
1050	-	1110 Hz	@	0.18 (g rms) <sup>2</sup> /Hz
1110	-	1160 Hz	@	+91.81 dB/oct
1160	-	1190 Hz	@	0.69 (g rms) <sup>2</sup> /Hz
1190	-	1260 Hz	@	-55.62 dB/oct
1260	-	1320 Hz	@	0.24 (g rms) <sup>2</sup> /Hz
1320	-	1440 Hz	@	+132.33 dB/oct
1440	-	1490 Hz	@	11.00 (g rms) <sup>2</sup> /Hz
1490	-	1510 Hz	@	-295.61 dB/oct
1510	-	1550 Hz	@	2.97 (g rms) <sup>2</sup> /Hz
1550	-	1600 Hz	@	+91.92 dB/oct
1600	-	1660 Hz	@	7.83 (g rms) <sup>2</sup> /Hz
1660	-	2000 Hz	@	-26.91 dB/oct
		2000 Hz	@	1.48 (g rms) <sup>2</sup> /Hz

Random composite reference level = 58.59 g rms

##### Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.7 g rms at 500 Hz, 1.34 g rms at 600 Hz, 15.5 g rms at 1000 Hz and 28.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.7 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 28.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 66.88 g rms

Y axis (component axis)

Steady-state random vibration amplitudes-R4:

20 -	240 Hz	@ 0.22 (g rms) <sup>2</sup> /Hz
240 -	410 Hz	@ -1.79 dB/oct
410 -	460 Hz	@ 0.16 (g rms) <sup>2</sup> /Hz
460 -	480 Hz	@ -64.81 dB/oct
480 -	630 Hz	@ 0.064 (g rms) <sup>2</sup> /Hz
630 -	650 Hz	@ +52.17 dB/oct
650 -	670 Hz	@ 0.11 (g rms) <sup>2</sup> /Hz
670 -	700 Hz	@ +145.21 dB/oct
700 -	730 Hz	@ 0.91 (g rms) <sup>2</sup> /Hz
730 -	740 Hz	@ -398.88 dB/oct
740 -	770 Hz	@ 0.15 (g rms) <sup>2</sup> /Hz
770 -	800 Hz	@ +192.59 dB/oct
800 -	840 Hz	@ 1.73 (g rms) <sup>2</sup> /Hz
840 -	860 Hz	@ +83.39 dB/oct
860 -	1060 Hz	@ 3.32 (g rms) <sup>2</sup> /Hz
1060 -	1110 Hz	@ -15.22 dB/oct
1110 -	1190 Hz	@ 2.63 (g rms) <sup>2</sup> /Hz
1190 -	1200 Hz	@ -98.51 dB/oct
1200 -	1330 Hz	@ 2.0 (g rms) <sup>2</sup> /Hz
1330 -	1350 Hz	@ +501.17 dB/oct
	1350 Hz	@ 24.0 (g rms) <sup>2</sup> /Hz
1350 -	1380 Hz	@ -340.34 dB/oct
1380 -	1430 Hz	@ 2.0 (g rms) <sup>2</sup> /Hz
1430 -	1450 Hz	@ +127.4 dB/oct
1450 -	1530 Hz	@ 3.6 (g rms) <sup>2</sup> /Hz
1530 -	1600 Hz	@ +22.11 dB/oct
	1600 Hz	@ 5.0 (g rms) <sup>2</sup> /Hz
1600 -	1650 Hz	@ -89.6 dB/oct
1650 -	2000 Hz	@ 2.0 (g rms) <sup>2</sup> /Hz

Random composite reference level = 60.71 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 3.0 g rms at 500 Hz, 1.6 g rms at 600 Hz, 53.3 g rms at 1000 Hz and 57.0 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 3.0 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 57.0 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr

Total composite level = 98.93 g rms

(Zone U-1)

Z axis (component axis)

Steady-state random vibration amplitudes-R4:

20	-	130 Hz	@	0.1 (g rms) <sup>2</sup> /Hz
130	-	320 Hz	@	-1.82 dB/oct
320	-	390 Hz	@	0.058 (g rms) <sup>2</sup> /Hz
390	-	430 Hz	@	+16.79 dB/oct
430	-	480 Hz	@	0.1 (g rms) <sup>2</sup> /Hz
480	-	500 Hz	@	-16.46 dB/oct
500	-	630 Hz	@	0.08 (g rms) <sup>2</sup> /Hz
630	-	690 Hz	@	+7.38 dB/oct
690	-	780 Hz	@	0.1 (g rms) <sup>2</sup> /Hz
780	-	820 Hz	@	+90.54 dB/oct
820	-	860 Hz	@	0.45 (g rms) <sup>2</sup> /Hz
860	-	890 Hz	@	+29.54 dB/oct
890	-	960 Hz	@	0.63 (g rms) <sup>2</sup> /Hz
960	-	990 Hz	@	-90.42 dB/oct
		990 Hz	@	0.25 (g rms) <sup>2</sup> /Hz
990	-	1190 Hz	@	+23.00 dB/oct
1190	-	1330 Hz	@	1.02 (g rms) <sup>2</sup> /Hz
1330	-	1350 Hz	@	+578.95 dB/oct
		1350 Hz	@	18.0 (g rms) <sup>2</sup> /Hz
1350	-	1380 Hz	@	-393.16 dB/oct
1380	-	1450 Hz	@	1.02 (g rms) <sup>2</sup> /Hz
1450	-	1460 Hz	@	+387.37 dB/oct
1460	-	1470 Hz	@	2.47 (g rms) <sup>2</sup> /Hz
1470	-	1510 Hz	@	-99.17 dB/oct
1510	-	2000 Hz	@	1.02 (g rms) <sup>2</sup> /Hz

Random composite reference level = 37.35 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 4.1 g rms at 500 Hz, 2.6 g rms at 600 Hz, 19.8 g rms at 1000 Hz and 34.3 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 4.1 g rms from 350 Hz to 620 Hz to 350 Hz at 270 Hz/min and 34.3 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 54.66 g rms.

4.5.22 SSME Vibration Criteria Zone V (Sensors)

This zone includes the turbine temperature sensors. Vibration amplitudes are as follows:

Transducer Type X-ITransient shock spectrum-R4: (engine axes)

(combined zones G and I)

10 Hz @ 6.0 g peak  
30 Hz @ 28.0 g peak  
60 Hz @ 53.0 g peak  
220 Hz @ 104 g peak  
320 Hz @ 200 g peak  
950 Hz @ 157 g peak  
1250 Hz @ 280 g peak  
1450 Hz @ 230 g peak  
2000 Hz @ 340 g peak

Steady-state random vibration amplitudes-R4:

20 - 160 Hz @  $0.03 (g \text{ rms})^2/\text{Hz}$   
160 - 200 Hz @ +25.59 dB/oct  
200 - 850 Hz @  $0.2 (g \text{ rms})^2/\text{Hz}$   
850 - 950 Hz @ +36.83 dB/oct  
950 - 1120 Hz @  $0.78 (g \text{ rms})^2/\text{Hz}$   
1120 - 1240 Hz @ +75.45 dB/oct  
1240 - 1300 Hz @  $10.0 (g \text{ rms})^2/\text{Hz}$   
1300 - 1340 Hz @ -126.45 dB/oct  
1340 - 1380 Hz @  $2.8 (g \text{ rms})^2/\text{Hz}$   
1380 - 1410 Hz @ +86.65 dB/oct  
1410 - 1450 Hz @  $5.2 (g \text{ rms})^2/\text{Hz}$   
1450 - 1605 Hz @ -46.04 dB/oct  
1605 - 1710 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$   
1710 - 1870 Hz @ +10.44 dB/oct  
1870 - 1930 Hz @  $1.5 (g \text{ rms})^2/\text{Hz}$   
1930 - 1985 Hz @ -33.23 dB/oct  
1985 - 2000 Hz @  $1.1 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 54.05 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 1.1 g rms at 250 Hz, 7.3 g rms at 500 Hz, 9.0 g rms at 600 Hz, 4.4 g rms at 1000 Hz, 5.1 g rms at 1200 Hz and 10.5 g rms at 2000 Hz for 6.5 hr.

(Zone V)

Sinusoidal sweeps of 9.0 g rms from 200 Hz to 1240 Hz to 200 Hz at 340 Hz/min and 10.5 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 56.68 g rms

Transducer Type X-2

Transient shock spectrum-R4: (engine axes)

X, Y and Z axes (Q=10) 120 pulses

10 Hz @ 1.0 g peak  
30 Hz @ 40.0 g peak  
800 Hz @ 60.0 g peak  
2000 Hz @ 150 g peak

Steady-state random vibration amplitudes-R4:

20 - 150 Hz @  $0.007 (g \text{ rms})^2/\text{Hz}$   
150 - 230 Hz @ +7.03 dB/oct  
230 - 250 Hz @  $0.019 (g \text{ rms})^2/\text{Hz}$   
250 - 270 Hz @ +10.73 dB/oct  
270 - 290 Hz @  $0.025 (g \text{ rms})^2/\text{Hz}$   
290 - 430 Hz @ -5.61 dB/oct  
430 - 540 Hz @  $0.012 (g \text{ rms})^2/\text{Hz}$   
540 - 700 Hz @ +13.97 dB/oct  
700 - 820 Hz @  $0.04 (g \text{ rms})^2/\text{Hz}$   
820 - 910 Hz @ +2.76 dB/oct  
910 - 1100 Hz @  $0.044 (g \text{ rms})^2/\text{Hz}$   
1100 - 1140 Hz @ -16.91 dB/oct  
1140 - 1180 Hz @  $0.036 (g \text{ rms})^2/\text{Hz}$   
1180 - 1320 Hz @ +10.88 dB/oct  
1320 - 1380 Hz @  $0.054 (g \text{ rms})^2/\text{Hz}$   
1380 - 1420 Hz @ +40.08 dB/oct  
1420 - 1490 Hz @  $0.079 (g \text{ rms})^2/\text{Hz}$   
1490 - 1510 Hz @ -65.90 dB/oct  
1510 - 1540 Hz @  $0.059 (g \text{ rms})^2/\text{Hz}$   
1540 - 1800 Hz @ +43.08 dB/oct  
1800 - 2000 Hz @  $0.55 (g \text{ rms})^2/\text{Hz}$

Random composite reference level = 14.84 g rms

Superimposed steady-state sinusoids-R4:

Sinusoidal dwells of 2.0 g rms at 500 Hz, 2.5 g rms at 600 Hz, 1.3 g rms at 1000 Hz, and 4.9 g rms at 2000 Hz for 6.5 hr.

Sinusoidal sweeps of 2.5 g rms from 350 Hz to 1040 Hz to 340 Hz at 300 Hz/min and 4.9 g rms from 1400 Hz to 2000 Hz to 1400 Hz at 600 Hz/min for 1.0 hr.

Total composite level = 16.01 g rms

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PART V

TRANSPORTATION AND HANDLING

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## SECTION I. TRANSPORTATION AND HANDLING TEST REQUIREMENTS AND PROCEDURES

Transportation and handling specifications should be used for designing and testing component shipping containers. These specifications should not influence component design, but should provide information for shipping container design to ensure that the vibration amplitudes transmitted to the component do not exceed the design amplitudes.

### A. Transportation

Transportation specifications are generally presented as amplitudes in G's peak for sinusoidal sweep tests. Components should be monitored for resonance; dwell tests of 15 min each are required at each major resonance as noted during the sweep. If a component is shipped by rail, a shock test will be required to represent the train humping conditions. Any shock pulse may be used that results in a spectrum at least as severe as that specified.

Transportation tests may be eliminated if proof of adequate component protection can be provided.

### B. Handling

Handling specifications are required to account for typical conditions that occur during loading or unloading operations. Tests for these conditions consist of numerous container drops from various orientations of the container.

Handling tests may be eliminated if proof of adequate component protection can be provided.

## SECTION II. TRANSPORTATION SPECIFICATIONS

### A. Vibration

Vibration test frequencies should be swept logarithmically from 5 Hz to the maximum frequency and back to 5 Hz at 1 oct/min in each of three mutually perpendicular axes. Criteria below 5 Hz are for design consideration only, and no test is required. A 15 minute dwell is required at each major component resonance at the amplitude specified for the sweep test.

#### 1. Aircraft

- Jet (5-200-5 Hz @ 1 oct/min)

- 5 - 10 Hz @ 0.032 in. D. A. Disp.
- 10 - 35 Hz @ 0.11 G's peak
- 35 - 200 Hz @ 0.0017 in. D. A. Disp.
- 200 - 2000 Hz @ 3.5 G's peak

- Propeller (5-700-5 Hz @ 1 oct/min)

- 2 - 4 Hz @ 0.42 in. D. A. Disp.\*
- 4 - 5 Hz @ 0.35 G's peak\*
- 5 - 12 Hz @ 0.35 G's peak
- 12 - 55 Hz @ 0.046 in. D. A. Disp.
- 55 - 300 Hz @ 7.0 G's peak
- 300 - 700 Hz @ 3.5 G's peak

- Helicopter (5-600-5 Hz @ 1 oct/min)

- 5 - 12 Hz @ 0.22 in. D. A. Disp.
- 12 - 40 Hz @ 1.6 G's peak
- 40 - 55 Hz @ 0.019 in. D. A. Disp.
- 55 - 120 Hz @ 3.0 G's peak
- 120 - 170 Hz @ 0.0040 in. D. A. Disp.
- 170 - 220 Hz @ 6.0 G's peak
- 220 - 260 Hz @ 0.0024 in. D. A. Disp.
- 260 - 600 Hz @ 8.0 G's peak

\* Design Criteria Only — no test required.

## 2. Trucks

- Smooth Paved Roads (5-300-5 Hz @ 1 oct/min)

1 - 4 Hz @ 0.43 in. D. A. Disp.\*  
4 - 5 Hz @ 0.35 G's peak\*  
5 - 150 Hz @ 0.35 G's peak  
150 - 300 Hz @ 0.06 G's peak

- All Road Conditions (5-1000-5 Hz @ 1 oct/min)

1 - 7 Hz @ 1.7 G's peak\*  
7 - 15 Hz @ 1.7 G's peak  
15 - 1000 Hz @ 0.7 G's peak

## 3. Trains

- Normal Railroad Operations (5-2000-5 Hz @ 1 oct/min)

2 - 3 Hz @ 2.6 in. D. A. Disp.\*  
3 - 6 Hz @ 1.2 G's peak\*  
6 - 130 Hz @ 1.2 G's peak  
130 - 185 Hz @ 0.0014 in. D. A. Disp.  
185 - 2000 Hz @ 2.5 G's peak

## 4. Ships

- Normal Maneuvers (5-300-5 Hz @ 1 oct/min)

0.1 - 0.3 Hz @ 0.35 G's peak\*  
0.3 - 1.5 Hz @ 0.35 G's peak\*  
1.5 - 4 Hz @ 0.10 G's peak\*  
4 - 5 Hz @ 0.12 in. D. A. Disp.\*  
5 - 11 Hz @ 0.12 in. D. A. Disp.  
11 - 300 Hz @ 0.75 G's peak

### B. Shock

Shock tests should be conducted by applying five shocks in each of three mutually perpendicular axes (15 shocks total). Any shock pulse that results in a spectrum as severe as that presented below will be acceptable. The spectrum is based on the response of an undamped series of single-degree-of-freedom spring-mass systems.

## 1. Railroad

- Car Humping Conditions (5 shocks per axis)

20 - 160 Hz @ +6 dB/oct  
160 - 340 Hz @ 500 G's peak  
340 - 400 Hz @ -6 dB/oct

\* Design Criteria Only - no test required.

### SECTION III. HANDLING SPECIFICATIONS

Where equipment design allows, equipment shall be tested to handling specifications as described below. If normal equipment design does not allow this type testing, the procedures and required protection in handling are to be submitted to MSFC, ED23, for approval.

#### A. Transit Drop Test

This procedure shall be used for equipment, in its transit or combination case as prepared for field use, to determine if the equipment is capable of withstanding the shocks normally induced by loading and unloading of equipment.

#### B. Test Conditions

The test item shall be in its transit or combination case. For equipment 1,000 lb or less, the floor or barrier receiving the impact shall be of solid, 2-in. thick plywood, backed by either concrete or a rigid steel frame. For equipment over 1,000 lb, the floor or barrier shall be concrete or equivalent.

#### C. Performance of Test

Subject the test item to the number and heights of drop as required in Table XI. Upon completion of the test, the test item shall be operated and the results compared with the data obtained in accordance with the following:

Prior to proceeding with any of the test methods, the test item shall be operated under standard ambient conditions and a record made of all data necessary to determine compliance with required performance. These data shall provide the criteria for checking satisfactory performance of the test item either during, or at the conclusion of the test, or both, as required. Certification by signature and date block is required.

The test item shall then be visually inspected and a record made of any damage/deterioration resulting from the test. If a test chamber is used for the test, perform a visual inspection of the test item within the chamber at test conditions, when possible. Upon completion of the test, visually inspect the test item again after the test item has been returned to standard ambient conditions. Deterioration, corrosion, or change in tolerance limits or any internal or external parts which could in any manner prevent the test item from meeting operational service or maintenance requirements shall provide reason to consider the test item as having failed to withstand the conditions of the test.

TABLE IX. TRANSIT DROP TEST

Weight of Test Item and Case (lb)	Largest Dimensions (in.)	Notes	Height of Drop (in.)	No. of Drops
Under 100 lb Man-packed and Man-portable	Under 36	A	48	Drop on each face, edge, and corner.
	36 and over	A	30	Total of 26 drops
100 to 200 lb Inclusive	Under 36	A	30	Drop on each corner
	36 and over	A	24	
Over 200 to 1,000 lb Inclusive	Under	A	24	Total of 8 drops
	36 to 60	B	36	
	Over 60	B	24	
Over 1,000	No limit	C	18	4 edgewise drops 2 cornerwise drops

Note A. Drops shall be made from a quick-release hook; or drop tester as made by the L.A.B. Corporation, Skaneateles, New York, or equal. The test item shall be oriented so that upon impact a line from the struck corner or edge to the center of gravity of the case and contents is perpendicular to the impact surface.

Note B. With the longest dimension parallel to the floor, the transit or combination case, with the test item within, shall be supported at the corner of one end by a block 5 in. in height, and at the other corner or edge of the same end by a block 12 in. in height. The opposite end of the case shall then be raised to the specified height at the lowest unsupported corner and allowed to fall freely.

Note C. While in the normal transit position, the case and contents shall be subjected to the edgewise and cornerwise drop test as follows (if normal transit position is unknown, the case shall be oriented such that the two longest dimensions are parallel to the "floor").

1. Edgewise Drop Test. One edge of the base of the case shall be supported on a sill 5 to 6 in. in height. The opposite edge shall be raised to the specified height and allowed to fall freely. The test shall be applied once to each edge of the base of the case (total of four drops).
2. Cornerwise Drop Test. One corner of the base of the case shall be supported on a block approximately 5 in. in height. A block normally 12 in. in height shall be placed under the other corner of the same end. The opposite end of the case shall be raised to the specified height at the lowest unsupported corner and allowed to fall freely. This test shall be

applied once to each of two diagonally opposite corners of the base (total of two cornerwise drops). When the proportions of width and height of the case are such as to cause instability in the cornerwise drop test, edgewise drops shall be substituted. In such instances two more edgewise drops on each end shall be performed (four additional edgewise drops for a total of eight edgewise drops).